Railway Age

DAILY EDITION

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EDITORIAL

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A. R. E. A. Program

The program for today is as follows, the morning session convening at 9 a. m.:

Rules and Organization	**Bulletin 263**
Signs, Fences and Crossings	**Bulletin 264**
Masonry	**Bulletin 264**
Records and Accounts	**Bulletin 264**
Economics of Railway Labor	**Bulletin 264**
Wood Preservation	**Bulletin 265**

Co-operative Relations with Universities.
New business.
Election and Installation of Officers.
Adjournment.

A Practical Suggestion

One feature of the A.R.E.A. Bulletins, entirely aside from the outstanding technical value of their contents, is the high standard of accuracy which prevails in their publication. The singular freedom from typographical errors is a credit to the secretary who also performs the duties of editor. However, attention may well be directed to one feature in which there is room for improvement. Several of this year's committee reports include graphical charts which are seriously lacking in legibility. This has resulted from the fact that they have been prepared in accordance with a practice which gives entire satisfaction for office or field use, but which will not give good results in reproduction in engravings. The rulings on the cross section papers on which such charts are commonly plotted are so closely spaced that satisfactory reproduction to a smaller scale cannot be had in the engraving process. Better results could be obtained if the committees would arrange to have all charts traced on plain cloth, with lettering of sufficient size to be legible after reduction and with the finer sub-divisions of the cross section rulings omitted.

Economics of Signaling Affects Engineering

During the last few years, automatic signals have been recognized more and more as an aid in the movement of trains over the road; in fact, the idea of safety is now a secondary consideration in the authorization of such installations. Ways of increasing the capacity of single track lines are discussed in the report of the Committee on Economics of Signaling which will be presented at the convention of the Signal section, A. R. A., at the Drake hotel on Friday morning. Engineering and operating officers have a special interest in the conclusions of this report, for in making extensive studies of train delays the committee has found that they are caused by various factors which are classed under seven heads, including: (a) improper location of sidings; (b) improper location of fuel and water stations; (c) stopping for train orders, and (d) inadequate communication systems. The report also includes the results of an extensive study of the cost of freight train delays. Based on freight train service unit costs compiled by the Interstate Commerce Commission, Bureau of Statistics, the committee has established a cost of $21.07 per freight train hour. If, by the introduction of signaling or proper location of sidings, it is possible to eliminate 1.25 hr. of the delay, there will be a saving, for 20 trains a day (10 each way), of 25 train hours a day. At $21.07 per hour this will amount to $192,264 a year. The Signal section is in a position to recommend signaling to eliminate train stops for train orders, and train stops when entering or leaving sidings. However, the engineering department is primarily responsible for the location of sidings and watering stations. Therefore, in order to get a discussion of all phases of this subject, it is to be hoped that as many of the members of the A. R. E. A. as possible will attend this Signal section meeting on Friday morning.

Private Versus Government Ownership

Sir Henry Thornton's address last evening indicated the reasons why such a large proportion of the railroads outside of this country are owned and operated by the state. His extensive railroad experience in this country, England and Canada, has especially fitted him to discuss this question. His big contribution last evening was to indicate exactly what things are necessary if our privately owned railroads are to escape from government ownership. They must observe three cardinal principles—maintain solvency, furnish adequate transportation at reasonable rates, and pay wages which will enable the employees to live to a reasonable standard. More than this, however, they must take into consideration a social

or psychological factor—"the increasing spirit of discontent and dissatisfaction in the masses of the public in all countries with respect to the distribution of wealth." This may seem aside from the mark, but Sir Henry clearly emphasized the importance of giving it the most serious consideration. This was very evident when he answered the question as to the responsibility which rests upon those who have it within their power to influence the minds of men. "It seems to me," he said, "that it is their responsibility to so administer the affairs in their charge as to permit the advancement of social life and the development of economic problems by evolution rather than be revolution, and, above all, to speed on the work of educating each oncoming generation; for, in a democracy, the government can possess no greater intelligence than that which is born of the average intelligence of the electorate." The address in question was so logically arranged and clearly expressed that it has been reproduced in large part in the account of the dinner which is published elsewhere in this issue.

Make Facts the Basis of Thinking

Demagogues, such as mentioned by Mr. Sargent in his address at the dinner yesterday evening, have always been with us and are not any more thoughtless or unscrupulous now than they were in the early days. Social, political and industrial questions, however, are so much more complicated than they used to be, and the results of a wrong policy may be so much more disastrous and far reaching, that their attacks must be met with greater skill and must not be allowed to go unanswered or unchallenged. The difficulty is that the statements of these men, which will not stand the pitiless light of actual facts, appeal to those who are largely superficial in their thinking or who will not take pains to dig out the real facts. This makes the problem all the more difficult for the railroads. It means that the answers or the facts must be presented in a simple way and in such a form as to appeal to the intellects of those who are misled by the demagogues. This requires patience, perseverance and special skill. It will be well worth the cost, however. In this connection it may not be amiss to quote a few sentences from the Golden Rule Pledge of the Philadelphia Chamber of Commerce: "Our representative government is controlled by public opinion. Public opinion is based upon ignorance, illusion, prejudice *or* knowledge, truth, judgment. Representative government will be maintained or destroyed by public opinion! Public opinion is what men think. *Our problem is * * * to make facts the basis of thinking.*"

Further Studies on Painting

THE REPORT OF THE Committee on Buildings, which was presented yesterday, contained, among other information and data, a report on paints for railway buildings for adoption in the Manual. The work of the sub-committee on this subject covered the basic principles of the purpose, purchase and application of paints. Some interesting facts were contained in the report, particularly in regard to the purchase of paints and the matter of records. A form was suggested for the tabulation of detailed comparisons of costs and performances of various products. These comparisons, with the main emphasis on costs, are becoming more and more necessary and it is to be hoped that the roads will find it possible to record more data of that nature. A logical continuation of the work of this section of the Committee on Buildings would be a study of methods of painting and their costs. This is suggested because of the development and increased use of mechanical painting. A number of large railroads have found the use of this class of equipment an effective means of overcoming the handicap of the deferred maintenance programs inherited from the period of government control. Although detailed figures on the cost of this method of painting are not to be found generally, there are enough roads which have fairly complete data on the results obtained from mechanical painting to make the study of the subject worth while as a matter of general information for the Association.

What of Standardization?

WITH EACH PASSING convention the Manual receives new increments to its large fund of adopted standards of recommended practice, and what was once a book of modest proportions is rapidly becoming an exceedingly formidable volume. The word "standard" as here used is perhaps a misnomer for although the Manual occupies a position of high standing in the libraries of the railroads and its contents have been widely used as an authoritative guide in the drafting of rules in effect on the individual roads, its standards have not been generally adopted in toto by any large mileage of the railroads. There are noticeable exceptions to this rule, chief among which may be mentioned the Specifications for Steel Railway Bridges.

It is because of this failure of the roads to make a more general use of the A.R.E.A. standards that the Committee on Standardization was organized and instructed to ascertain what steps should be taken to make the standards more generally effective. More recently a new factor has been introduced through the creation of the American Engineering Standards Committee, whose function it is to effect the co-operative participation of all organizations having to do with any material or practice in the developing of any standard specifications, grades, rules, etc., applicable to American industry. This movement has received no little impetus through the active sponsorship of Secretary Hoover.

Publicity concerning the work of the American Engineering Standards Committee, particularly with reference to matters concerning railway engineers, has frequently given expression to the thought that there are many lines in which the problems of standardization concern only the railroads or at least only the railroads and manufacturers directly involved. On the other hand, there are those who do not subscribe to this view and who feel that every effort should be made to enlist the co-operation of all organizations that may be presumed to have even remotely comparable problems or interests.

In justification of the first view it has been pointed out that the more organizations whose interests must be reconciled in developing any standard, the greater is the probability that the proposed standard will not be acceptable to the individual participating organizations. This is a particularly vital point in connection with the A.R.E.A. since its own standards, while not generally accepted in their entirety, have a long established standing in railway circles. Therefore, efforts to establish national standards as contrasted with A.R.E.A. standards for such materials or practices as are peculiar to the railroads, would necessarily result in some confusion, and in view of the opinions expressed on Tuesday in the discussion of the report of the A.R.E.A. Committee on Standardization, it is apparent that any efforts to secure the adoption of national standards involving any marked departure from those already adopted by the A.R.E.A. will encounter serious opposition.

An Early Start

The attention of the members of the American Railway Engineering Association is called to the fact that the convention will be called to order promptly at nine o'clock this morning.

* * *

The Atchison, Topeka & Santa Fe has awarded a contract to the Sharp & Fellows Construction Company, Los Angeles, for the construction of 44 miles of double track between Summit, Cal., and Hicks. This work will include 800,000 yards of earth and heavy rock excavation.

* * *

The "Harriman Lines" officers and those who were formerly on these lines, but now are in other locations, held their annual gathering last night at the Drake hotel. This meeting is held each year in connection with the meeting of the Signal section of the American Railway Association.

* * *

The Southern Pacific has ordered 196 Style B signals from the Union Switch & Signal Company for installation on its line between Los Angeles and El Paso. The Pacific Electric has also ordered from the same company color light signals for installation on its double track between Dominguez and San Pedro.

* * *

The attendance at the Coliseum has broken all previous records. On Monday it exceeded 6,200 while on Tuesday it reached 12,084. Although the figures for the attendance yesterday were not available last evening, the Coliseum was crowded throughout the day. The combined attendance of 18,284 of the first two days compares with 10,515 for the same period last year.

* * *

An idea of the character of the attendance at the convention was to be had from an observation made by one railway officer yesterday afternoon, who noted that the Illinois Central was represented by the operating vice-president, the chief engineer, the engineer maintenance of way, the engineer of construction and all four of the district engineers, in addition to a large number of officers of other rank.

* * *

Robert Armour, for many years masonry engineer of the Grand Trunk and its successor, the Canadian National, has recently retired after 53 years of continuous service with the property. His first connection was with the Great Western Railway of Canada, which was later absorbed by the Grand Trunk. Mr. Armour has been a regular attendant at the A. R. E. A. conventions since he became a member of the association in 1908, and has served continuously since that time as a member of the Masonry committee. Mr. Armour's retirement does not entirely sever his connection with the railroad since he will continue to act in a consulting capacity.

* * *

Fred Wyant, assistant signal engineer of the Chicago, Rock Island & Pacific, has been promoted to acting signal engineer, with headquarters at Chicago, succeeding H. K. Lowry who has resigned to become signal engineer with the Sprague Safety Control & Signal Corporation. C. E. Hartvig, special engineer in charge of automatic train control installation, has been appointed principal assistant signal engineer in place of Mr. Wyant.

* * *

Among those who came from a distance to attend the exhibit at the Coliseum yesterday were three officers of the Railways of Netherlands (der Nederlandshe Spoorwegen), who are now in this country studying railway practices, especially signaling. The group consists of Ir A. van Driel van Wageningen, chief signal engineer; H. P. Mass Geesteranus, chief of service of ways and works, and Ir J. H. Verstegen, engineer, all of the Railways of Netherlands, with headquarters at Utrecht. This committee has inspected the factories of several signal manufacturers and also the lines of eastern roads, among which is the New York Central.

* * *

The Canadian National has established a high record for attendance at this year's convention, and, with possibly one or two exceptions, for all conventions, a total of 76 officers being present from the lines of the Canadian National system, including the Grand Trunk and the Central of Vermont. Among these men were: C. B. Brown, chief engineer, system; C. Gzowski, chief engineer, construction; F. L. C. Bond, chief engineer, Central region; D. Fitzpatrick, chief engineer, Central of Vermont, and T. T. Irving, chief engineer, Grand Trunk, Lines West of Detroit and the St. Clair rivers. In addition to this large delegation, Sir Henry W. Thornton, chairman of the Board of Directors and president of the Canadian National system, was the guest of honor and one of the principal speakers at the dinner last evening.

Signal Section Program

Morning sessions, 10 a. m. to 12:30 p. m.; afternoon sessions, 2 p. m. to 5 p. m.

Today

Consideration of minutes of November, 1923, stated meeting.
Address of the chairman.
Resolution of Committee of Direction on death of W. W. Slater.
Report of Committee of Direction.
Report of the Secretary.
Sub-committee of Administrative Committee on Editing.
Special committee on Highway Crossing Protection.
Committee on Mechanical Interlocking.
Presentation of paper by H. G. Morgan.
Committee on Instructions.
Committee on Chemicals.
Committee on Designs.

Friday, March 14th

Committee on Contracts and Valuation.
Committee on Alternating Current Automatic Block Signaling.
Committee on Signaling Practice.
Committee on Economics of Railway Signaling.
Committee on Power Interlocking.
Committee on Direct Current Automatic Block Signaling.
Committee on Overhead and Underground Lines.
Unfinished business.
New business.
Reports for discussion.
Election announcement.
Adjournment.

Liberty Lake, Illinois Central Water Supply Reservoir at Princeton, Ky.

Engineers Tax Florentine Room to Capacity

Both Morning and Afternoon Sessions Were Characterized by Active Interest

The convention of the American Railway Engineering Association was called to order promptly at nine o'clock yesterday morning by President Lee and the consideration of the reports of standing committees was undertaken at once. The large registration was evidenced by the crowd which taxed the capacity of the room at practically all times during the day. The valuable character of the reports was indicated by the active discussion.

Reports were presented by the committees on Iron and Steel Structures; Electricity; Roadway; Stresses in Railroad Track; Shops and Locomotive Terminals; Rail; Track; Yards and Terminals and Economics of Railway Operation.

Report on Shops and Locomotive Terminals

Last year the Committee on Shops and Locomotive Terminals submitted a report on ash pits, the conclusions of which were adopted for publication in the Manual. This year, as a further step in its studies on the design and layout of engine terminal facilities, the committee presented a report on typical layouts for the storage and distribution of fuel oil. This report discusses the variations in the character of fuel oil, the development of its use, the facilities that are required by the railways for unloading the oil from tank cars, for holding it in storage, for heating it when necessary, and for delivering it to locomotive tenders, together with the necessary pumps and pipe lines for transferring the oil. F. E. Morrow has been chairman of the committee since its organization.

F. E. Morrow
Chairman

The committee presented a report on typical layouts for storage and distribution of fuel oil (Appendix "A"), and recommended that the conclusions given be approved for publication in the Manual.

Committee: F. E. Morrow (C. & W. I.), chairman; A. T. Hawk (C. R. I. & P.), vice-chairman; A. L. Atwill (C. C. & W. I.), C. N. Bainbridge (C. M. & St. P.), G. W. Burpee (Con. Engr.), Leland Clapper (D. & I. R.), K. B. Duncan (G. C. & S. F.), G. H. Gilbert (Sou.), Walter Goldstraw (G. T.), E. M. Haas (Con. Engr.), R. J. Hammond (B. & M.), Geo. W. Hand (C. & N. W.), G. W. Harris (A. T. & S. F.), R. L. Holmes (M. P.), L. P. Kimball (B. & O.), W. T. Krausch (C. B. & Q.), L. H. Laffoley (C. P. R.), J. S. McBride (C. & E. I.), J. M. Metcalf (M. K. & T.), J. W. Pfau (N. Y. C.), John Schofield (C. N. R.), L. K. Sillcox (C. M. & St. P.), B. S. Voorhees (N. Y. C.), J. M. Weir, A. M. Zabriskie (C. R. R. of N. J.)

Appendix A—Typical Layouts for Storage and Distribution of Fuel Oil

The use of oil as fuel for locomotives is a development of the past 25 years, and has been widely extended since the war, as a result of the steadily rising cost of coal, coupled with largely increased production of resi-

duum fuel oil as a by-product of the petroleum industry. Various elements in addition to the purchase cost per thermal unit enter into any consideration of the relative economy of oil and coal. Such are the saving in transportation cost due to the fact that the fuel value of oil per pound is about fifty per cent greater than that of bituminous coal; the reduction of waste and loss in handling and storing; the elimination of the soot and cinder nuisance and of damage due to spark-set fires; the possible increase in the length of engine runs and the reduction in the number of stops required for receiving fuel and cleaning fires. On the other hand, there is the increased cost of locomotive firebox and boiler maintenance due to the higher temperature of oil fires, and increased investment in facilities for handling and storing fuel.

There is a wide variation in the character of fuel oils, but the temperature at which the oil may be handled successfully and the extent of heating required to maintain that temperature are the main factors affecting variations in detail of design. The heavy Mexican crude or "topped" oil, with asphalt base and gravity as low as 10 to 12 deg. (Baume) is largely used by roads having access to gulf ports. This oil, when cold, is so thick and viscous as not to flow, and must be heated to temperature of 100 deg. to 140 deg. to permit satisfactory handling. The lighter residuum fuel oil from the mid-continent fields, on the other hand, with paraffin base and gravity between 25 and 28 deg. (Baume) flows like water at ordinary temperature and requires heating only during extreme cold.

Oil is commonly delivered in tank cars for distribution to the various engine terminals. The Mexican oil is transported by tank steamers from Mexican ports to the gulf port and unloaded direct through pipe lines from the steamer to storage tanks. From the storage tanks it is pumped through loading racks to tank cars, as required for distribution. The domestic oil is delivered from the oil companies either direct to tank cars or to conveniently located storage tanks owned by the railroads.

The facilities required by the railroads include provision for unloading the oil from the tank cars, for holding it in storage, and for delivering it to locomotive tenders, together with the necessary pumps and connecting pipe lines for transferring the oil between such facilities.

Conclusions

General

1. Where oil is used as fuel for locomotives the facilities required include provision for unloading it from cars, for holding it in storage, and for delivering it to locomotive tenders.

2. The details of design necessarily vary with the composition and gravity of the oil to be used and the climatic conditions to be encountered, as they affect the temperature which must be maintained in the oil for convenient handling.

Unloading Facilities

3. Oil should be unloaded from tank cars by discharging direct into a trough or boxes of steel or concrete between the rails of track on which cars stand for unloading. Where boxes are used, they should be spaced at car-length intervals for convenience in spotting cars for unloading.

4. Unloading trough or boxes should deliver oil by gravity through pipe line to a depressed sump from which it may be pumped to the storage or delivery tank. Such pipe line should be of sufficient size and be laid with sufficient gradient so that the oil will flow by gravity to the sump as fast as it will be discharged from the total number of cars which will be opened at any time. This should not be in excess of the capacity of the pumps.

5. Sumps may be of steel or reinforced concrete and should be covered. They should have capacity of not less than one carload. If of steel, the pit should be drained or the sump should be anchored to prevent displacement by ground water when empty.

Storage

6. The storage capacity which should be provided depends largely upon reliability and source of supply and probable variations in market price of oil. In general, there should be at each station sufficient storage to protect against any interruption which may occur in the delivery from the regular source of supply. Additional storage for the purpose of taking advantage of variations in market conditions may either be located at various terminals where oil is used, or concentrated at one conveniently located point.

7. Cylindrical steel tanks of 55,000 and 80,000 bbl. capacity, erected on leveled earth foundations, provide convenient and economical storage, and can commonly be secured promptly and at less cost on account of being standard construction with tank manufacturers. Each tank should be surrounded by an earth dike, enclosing below the elevation of top of dike a volume equal to one and one-half times the capacity of the tank. Roofs should be provided of steel or of wooden frame and sheathing, covered with asbestos, composition, tar and gravel, or sheet metal roofing.

8. Adequate means should be provided for the escape of gases thrown off from the surface of the oil. The character and extent of such provision required will depend on the tightness of the roof and the character of the oil. It should be designed to reduce circulation of air over the surface of the oil to a minimum consistent with prevention of building up of pressure due to the accumulation of gases.

9. Provision should be made for draining off water and refuse which may settle in the bottom of tanks.

Delivery

10. Oil may be delivered to locomotive tenders by gravity from elevated steel tanks or under direct pump pressure. In general, the former method is more convenient and economical.

11. The size of delivery tank required varies with local conditions as to receipt and handling of oil, but the capacity should, in general, be not less than the average amount of oil to be delivered in 24 hours.

12. Valves should be provided for draining off water and refuse which may accumulate in the bottom of tanks.

13. Delivery columns should be so constructed that spout can be swung to position and valve opened from the locomotive tender to be served. Spouts should have maximum freedom of movement in both horizontal and vertical directions, consistent with prevention of leakage. They should be provided with drip bucket, reversible end elbow, or other means to prevent drip.

14. Means should be provided for measuring accurately deliveries of oil. Meters in delivery pipe lines or gages on engine tenders serve satisafctorily to that end.

15. Some wastage of oil around an engine terminal is inevitable and provision which will reduce such wastage to a minimum is an important item in design of facilities for handling oil. If all unnecessary waste and leakage is eliminated the cost of recovery of waste oil is generally in excess of the value of the oil. In cases where such waste is excessive or becomes a nuisance, however, and causes damage to neighboring property,

it becomes necessary to provide traps in drainage channels or sewers equipped with baffles, to catch the waste oil, separate it from water, and permit its recovery by dipping or pumping back to the sump. Such appliances are being used successfully.

Heating

16. Where heavy oil is used or where cold temperatures are experienced, it is necessary to provide means for heating oil in cars, tanks and pipe lines, in order that it may flow freely. Such heat is best provided by steam pipes.

17. Pipe coils in tank cars, which can be readily connected by flexible hose or pipe to steam pipe lines from the pump house, provide satisfactory means for heating before unloading. The discharge of live steam directly into the oil in the car may be resorted to in case the heating coils are out of order or the car is not equipped.

18. Similar steam pipe coils provide satisfactory heat for storage and delivery tanks. In larger tanks they are more effective if enclosed with the end of the discharge line leading from the tank in a wood box so that the heat will be applied directly to the oil as it leaves the tank, and not disseminated through the whole tank full of oil. The heating of oil in pipe lines will often prove advantageous and may be accomplished by introduction of small steam pipe lines inside the oil lines, or by enclosing steam line inside an insulating box alongside the oil line. The latter method simplifies construction and maintenance, but requires more expensive first installation and greater consumption of steam in proportion to the results obtained.

19. Where steam lines are installed in oil lines, it is necessary to take precaution against excessive heating. On this account it is not recommended that steam lines be so installed larger than necessary for heating the pipe line. Steam for tank coils and other purposes may better be carried outside the oil lines.

Small Stations

20. While the foregoing recommendations apply primarily to the larger stations, yet the general principles apply to the small stations except that their application requires special adaptation to the problem. In some cases, the oil is used direct from the cars, in other cases, storage from one or more cars is combined with delivery tanks, delivery being made either by gravity, pumps or air pressure.

Discussion

(The report was presented by J. M. Metcalf (M.-K.-T.), who *moved the adoption of the recommendations made for publication in the Manual.*)

H. M. Lull (S. P.): The committee has not made any definite recommendation in the description of the construction of these storage tanks as to the character of the roof construction. The question of the hazard of fire on these large storage tanks is quite large and there seems to be a tendency for a good many of these tanks to be struck by lightning, especially in territories where heavy thunderstorms occur. The users of oil as well as the large oil companies have given a great deal of study to the causes of fires of that character, which often involve very large loss. Nearly all the large oil companies have adopted a gas-tight steel roof with provision for leading off the gases by means of a breather pipe which is carried out of the roof and down along the ground to a point outside of the levee and with the provision of suitable valves in this pipe for the proper control of the gases, the theory being that the electric current for lightning discharge is attracted to the tank by the rise of gases in the air, if they are allowed to accumulate. It might be well to make a more definite recommendation in the Manual as to the character of the roof construction in these large storage tanks.

Mr. Metcalf: The committee found such a large variation in practice among the different roads in the matter of roofs that we didn't feel in a position to make a definite recommendation. We found very few roads using the gas-tight roofs. Many of us have felt that the additional expense on that account was not justified by experience, and the committee as a whole did not feel in a position at this time to make any definite recommendation.

Mr. Lull: I think that is because a great many roads using fuel oil have not realized sufficiently the importance of that phase of the subject. Has the committee made inquiries as to what the large oil companies such as the Standard and the Texas Company and Humble, etc., are doing in that respect?

Mr. Metcalf: The practice of the oil companies is to a large extent determined by the storage of a much more inflammable oil than the railroads use.

Chairman Morrow: The oil that is stored by the oil companies has not yet been refined in most cases, has not had the gasoline and other elements removed and most of the oil used by the railroads is the residue oil after more or less of the gasoline and other products have been removed. I think that the committee would be very glad to consider this point further for another year if the Association feels that such consideration is desirable.

Mr. Lull: The use of fuel oil in locomotives is increasing. I know of several roads which are seriously considering the adoption of oil for fuel. The engineers of those roads in designing their plants, would naturally look to this Manual for guidance.

As to the gravity of the oil used by the railroad companies, we probably use the heaviest grade of oil of any company operating, that is the Tampico oil which has a gravity of 11 or 12. One of our tanks at Galveston, which contained this heavy Tampico crude was struck by lightning a short time ago and we suffered a loss of about $70,000. It was only owing to assistance received from the fire department and several oil company organizations that we did not suffer a loss of about a half million dollars. I don't place any reliance whatever on heavy crude oil being exempt from fire.

W. H. Kirkbride (S. P.): Gas will form on oil irrespective of its gravity, and I think one of the important problems is to eliminate the storage of gas entirely. A canopy roof gathers the gas irrespective of the type, and the result is that if you do have a fire the gas is what sets the oil on fire. There has been developed, and we are trying it out in California, a floating roof, a steel roof that rests on the surface of the oil. It rises and falls as the oil level changes within the tank. The result is that all evaporation is eliminated.

I notice the committee also recommends that a storage of one and one-half times the tank supply be provided. I have found this difficult and furthermore I have never seen any evidence showing that one and a half times the capacity of the tank was necessary. My experience in tanks getting afire is that almost invariably the tank collapsed by falling and the oil would burn out before there was a rupture of the tank, and usually the rupture will be inward. Therefore, in reality there is little spilling of oil. If you can confine the oil it will burn itself out. The principal thing is to have one line of defense that is reasonable. I, therefore, question the advisability of going on record that you must provide one and a half times the capacity. Is this subject of storage being dis-

cussed only, or are you also discussing the question of unloading at this time?

Chairman Morrow: The report covers both the storage and delivery.

Mr. Kirkbride: It is a mistake to provide unloading troughs within the track centers. The theory being to spot the car on top of the track and let the oil discharge directly into an opening, between the ties or between the rails. That system is not correct. The unloading device should be a pipe system parallel to the track, with a small entry box, say 12 in. square, and the oil should be taken from the tank to the unloading pipe by means of a trough placed under the car and connecting with this 12 in. manhole. This makes the track system absolutely independent of the oil on it. The track man can surface the track and perform the usual track maintenance at any time without interference with the unloading device.

There is some hazard in having a sump within the track system, because locomotives will necessarily occasionally pass over these sumps. There is a hazard from fire due to the flash in the pan; very frequently men unloading oil make a mistake and a car of gasoline or a car of a greater flash than crude oil will be spotted through error. The question of fires is, therefore, apparent. It is my belief that the committee can develop a great deal more in connection with the question of unloading and storing oil.

Mr. Armstrong: Our experience with a large refinery confirms Mr. Kirkbride's opinion as to this unloading.

Mr. Morrow: In view of this discussion I think the committee would be very glad to make a further study of this and to that end I will withdraw the motion to adopt this as recommended practice this year.

(The committee was excused with thanks of the Association.)

Report on Stresses in Railroad Track

During the past year the Special Committee on Stresses in Track has been engaged in an extensive series of field tests on both straight and curved tracks. The studies which this committee has made in conjunction with a special committee on the same subject of the American Society of Civil Engineers have thrown much light on the complex problems of track. The work of the past year has involved tests with electric and steam locomotives, and with loaded freight cars, to determine the position of flanges on individual wheels and the stresses produced by various types of wheels. Other extensive tests were made to determine the effect of canting the rail. Professor A. N. Talbot has been chairman of this committee and the committee of the A. S. C. E. since they were organized.

Arthur N. Talbot
Chairman

THE YEAR 1923 has been occupied with both field and office work. An extensive series of tests was conducted on both straight and curved track on the electrified section of the Chicago, Milwaukee & St. Paul in Montana in July and August, and another series on four railroads in Virginia, West Virginia and Pennsylvania in September on track with the rail laid both on flat tie plates and on inclined tie plates.

The tests on the St. Paul were made at various speeds up to 60 miles an hour on straight track, 50 miles an hour on 6-deg. curve, and 40 miles an hour on 10-deg. curve. Several types of electric locomotives and a Mikado steam locomotive were used. Tests were also made with loaded freight cars on both straight and curved track. In addition to the tests made with the stremmatograph to determine the stresses in the two rails under the many and varied conditions referred to above, one of the methods involved the use of copper wire resting on the rail and pulled across it in the interval between the passage of one wheel and the next in such a way that the wire recorded separately impressions for each wheel that passed over it. The amount and the length of the flattenings of the wire, and their position gave information on the position of the wheel with respect to the rail and especially as to whether the flange bore strongly against the edge of the rail. As was to be expected, considerable difference was found in the position of the flanges for the several forms of locomotives used. An interesting set of tests, intended to determine the effect of the regenerative features of the electric locomotive upon flange wear, was made by coupling two electric locomotives together and running them around a 10-deg. curve, one motoring and the other regenerating. Sufficient progress in the office work of reading the records and reducing the data has been made to indicate that interesting comparisons may be expected of the stresses in rail produced by the various wheels of the several forms of electric locomotives and those produced by the steam locomotive, both on straight track and curved track.

The purpose of the tests made in the East was to try to determine the effect of canting the rail in producing changes in the stress in the rails, both on straight track and on curved track, as having a bearing on the wear of the rail and the maintenance of the track, as well as upon the strength of the rail. In all cases the runs were at 5 and 40 miles an hour, and heavily loaded coal cars were attached to the locomotive for these tests. Not enough progress has been made in working up the data to indicate whether conclusive evidence has been ob-

tained, but the many auxiliary observations on the tilting and lateral movement on the rails themselves promise to give information of real value.

Committee: Arthur N. Talbot (U. of Ill.), chairman; W. M. Dawley (Erie), vice-chairman; G. H. Bremner (C. B. & Q.), John Brunner (Ill. Steel Co.), W. J. Burton (M. P.), C. S. Churchhill (N. & W.), W. C. Cushing (Penna.), P. H. Dudley* (N. Y. C.), H. E. Hale (Pres. Conf. Com.), C. W. Gennet, Jr. (R. W. Hunt & Co.), J. B. Jenkins (B. & O.), George W. Kittredge (N. Y. C.), Paul M. LaBach (C. R. I. & P.), C. G. E. Larson (Am. Brg. Co.), G. J. Ray (D. L. & W.), Albert Reichmann (Am. Brg. Co.), H. R. Safford (C. B. & Q.), Earl Stimson (B. & O.), F. E. Turneaure (U. of Wis.), J. E. Willoughby (A. C. L.).

*Deceased.

Discussion

(Chairman Talbot reviewed the contents of the committee's report.)

Prof. Talbot: With reference to the work on the electrified portion of the C. M. & St. P., I may say that the records so far examined indicate a considerable difference that could be expected in the action of the loads of different locomotives on the rails, particularly on the curved track.

In regard to the work on canted as compared with the flat tie plates, an effort was made in three ways to determine some of the effects. First, the ratio of stresses on the outer edge to the inner edge of the rail indicated whether the rail has been on straight or curved track or whether it is being bent outwardly or inwardly. From that something can be determined as to the direction of the pressure of the load and whether it may be expected that the gage will widen and whether the rail will tilt. The second method was an actual measurement of the movement of the rail during the passage of the locomotive and loaded cars, to determine whether it moved outwardly or inwardly or whether it tilted with respect to its original position. The third method was the use of the copper wire to obtain the impression of the wheel as it passed the point and thus to find the bearing of the wheel and head of the rail.

So far, much of this work on the straight and curved track on the B. & O. has been carried out. It appears from the impressions made by the wire that for the given locomotive and cars used, the bearing on the head of the rail on straight track is more nearly central with the rail tilted. This would be expected from the fact that the coning of the wheels would bring the connection more nearly in the middle of the rail.

However, to show that not too much may be expected from a single test, a test on the straight track indicated that on one rail, say the south rail, the stresses varied markedly between the two conditions of canted rail and inclined flat tie plate. The inclined tie plate or canted rail tended to bend the rail inward and tilt the rail inward. On the straight track, on the flat tie plate the tendency was to move it outward. This difference was quite marked, for every wheel of the locomotive and the two cars. Strangely enough, on the other rail, the north rail of this straight track, there was very little difference between the effect of the canted rail and vertical rail. I think that it shows that we must take more than one set of tests and there may be local conditions which affect the result.

(The committee was excused with the thanks of the Association.)

Report on Iron and Steel Structures

The Committee on Iron and Steel Structures presented a large mass of valuable material for inclusion in the Manual which represents the completion of several years painstaking work. This includes rules for the classification of old bridges, specifications for the design of turntables, and for the design of steel highway bridges. A comprehensive list of revisions in the Specifications for Steel for Railway Bridges was also submitted for adoption. The question often raised as to the application of the electric welding process to steel bridge fabrication was also the subject of a brief report, from which it appears that the process of welding as applied to structural steel is still in an experimental stage. O. F. Dalstrom has been chairman of this committee for two years and a member for four years.

O. F. Dalstrom
Chairman

The committee's recommendations were:

1. That the progress report on Revision of Manual (Appendix A) be received as information and that the supplementary report containing recommended changes in the Specifications for Steel Railway Bridges be approved.

2. That the report on Classification of Bridges (Appendix B) be approved for publication in the Manual.

3. That the specifications for the Design of Turntables (Appendix C) be approved for publication in the Manual.

4. That the specifications for Steel Highway Bridges given in its Appendix D (too long to be reproduced here) be approved for publication in the Manual.

5. That the progress report on Electric Welding (Appendix E) be received as information.

9. That the progress report on Tests of I-Beams (Appendix F) be received as information.

11. That the progress report on Column Tests (Appendix G) be received as information.

Committee:

Committee: O. F. Dalstrom (C. & N. W.), chairman; B. R. Leffler (N. Y. C.), vice-chairman; F. Auryansen (L. I.),

A. W. Carpenter (N. Y. C.), M. F. Clements (N. P.), R. P. Davis (U. of W. Va.), F. O. Dufour (Lafayette Col.), Thos. Earle (Beth Steel Brg. Co.), W. R. Edwards (B. & O.), Robert Farnham (Penna), B. W. Guppy (B. & M.), G. A. Haggander (C. B. & Q.), Reuben Hayes (Sou.), Otis E. Hovey (Am. Brg. Co.), P. G. Lang, Jr. (B. & O.), P. B. Motley (C. P. R.), W. F. Rech (C. & A.), Albert Reichmann, Am. Brg. Co.), A. F. Robinson (A. T. & S. F.), H. N. Rodenbaugh (F. E. C.), O. E. Selby (C. C. C. & St. L.), I. L. Simmons (C. R. I. & P.), I. F. Stern (Con. Engr.), H. B. Stuart (C. N. R.), R. M. Stubbs (M-K-T), P. B. Spencer (N. Y. N. H. & H.), G. E. Tebbetts (C. & O.), F. E. Turneaure (U. of Wis.), F. P. Turner (N. & W.), J. A. L. Waddell (Cons. Engr.), H. T. Welty (N. Y. C.), W. M. Wilson (U. of Ill.).

Appendix A—Revision of Manual

The committee reported that it has undertaken work on two subjects looking toward revision of the General Specifications for Steel Railway Bridges and of the Specifications for Movable Railway Bridges, and reports progress thereon as follows:

(1) "Punched Work" and "Reamed Work"

The Specifications for Steel Railway Bridges make it optional with the Engineer to specify "Punch Work" or "Reamed Work." Since these specifications have come into general use, it is desirable that the necessity for these two classes of work should be investigated with a view to eliminating this option. The committee has been unable to find records of tests which would permit it to form a conclusion. It is proposed, therefore, to make tests to determine the relative values of the two kinds of work, and, if practicable, their relative costs.

(2) Bearing Pressure On Large Rollers

The Specifications for Movable Railway Bridges contain a formula limiting the bearing pressure between the segmental girder and the track girder of rolling lift bridges. Discussion has arisen as to whether that formula represents correctly the relations between elastic rollers of large diameter and their bearings. In order to establish definitely the relation between bearing pressure and area of contact, it is proposed to make tests on short segmental sections of rollers of large diameter.

Supplementary Report

The Committee submitted changes in the General Specifications for Steel Railway Bridges, with a view to eliminating non-essential differences in the specifications for materials, between the A.R.E.A. General Specification for Steel Railway Bridges and the A.S.T.M. Specifications for Structural Steel for Bridges. Most of these revisions are of a minor nature involving changes of wording or paragraph numbers. Following are some of the more important modifications:

Specifications for Steel Railway Bridges—1920

Article 157.—Change marginal title to "Physical Properties." Change number to 160, and change article to read as follows: "The steel shall conform to the following requirements as to physical properties, except as specified in Articles 162 and 163:

Properties Considered	Structural Steel	Rivet Steel
Tensile strength, lb. per sq. inch........	55,000—65,000*	46,000—56,000
Yield point, min., lb. per sq. inch......	30,000 a	25,000 a
Elongation in 8 in., min., per cent....	1,500,000 b / tens. str.	1,500,000 / tens. str.
Elongation in 2 in., min., per cent......	22	....

a In no case less than 0.5 tensile strength.
b See Article 163.

Article 170.—Change number to 168 and change article to read as follows:

"Test specimens for annealed material shall be prepared from the material as annealed for use, or from a short length of a full section similarly treated."

"Test specimens for rivet bars which have been cold-drawn shall be normalized before testing."

Article 171.—Change number to 169 and change article to read as follows:

"Test specimens shall be taken longitudinally and (except as specified in Articles 170 and 171) shall be of the full thickness or section of materials rolled.

"Test specimens for plates, shapes and flats may be machined to the form and dimensions shown in Fig. 5, or with both edges parallel. Bend test specimens for eye-bar flats may have three rolled sides."

Article 172.—Change number to 170 and change article to read as follows:

"Tension test specimens for material over 1½ inches in thickness or diameter, except pins and rollers, may be machined to a thickness or diameter of at least ¾ inch for a length of at least 9 inches, or they may conform to the dimensions shown in Fig. 6.

"Bend test specimens for material over 1½ inches in thickness or diameter, except eye-bar flats, pins and rollers, may be machined to a thickness or diameter of at least ¾ inch or to 1 by ½ inch in section."

Article 173.—Change number to 171 and change article to read as follows:

"Tension test specimens for pins and rollers shall conform to the dimensions shown in Fig. 6 and bend test specimens shall be 1 by ½ inch in section.

"The tension test specimen shown in Fig. 6 and the 1 by ½ inch bend test specimen for pins and rollers shall be taken so that the axis is 1 inch from the surface."

To the note at end of this article add the clause "in such a way that the load will be axial."

New article, to be given number 179, and marginal title "Inspection and Rejection." Article to read as follows:

"The inspector representing the Company shall have free entry at all times, while work on the contract of the Company is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspections shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

"The manufacturer shall furnish, without charge, test specimens, as specified herein, and all labor, testing machines and tools necessary to make the specimen and full-size tests."

New article to be given number 180, and to read as follows:

"Unless otherwise specified, any rejection based on tests made in accordance with Article 159 shall be reported within five working days from the receipt of the samples.

"Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notifed."

New article to be given number 181, and to read as follows:

"Samples tested in accordance with Article 159, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time."

Sub-division (XV) Mill and Shop Inspection. Change title and context of sub-division by eliminating reference to "Mill Inspection."

Appendix B—Classification of Railway Bridges

1. The classification of a bridge, as herein determined, is based on the heaviest moving load which may be operated over it in regular servce for a limited time without subjecting it to such severe stresses, vibration, or wear of parts as seriously to impair its safety or serviceability.

2. Iron and steel bridges shall be classified according to their rated carrying capacity as determined by the "Rules and Unit Stresses for Rating Existing Bridges," adopted by the American Railway Engineering Association in 1921, page 787 of the Manual, 1921.

Division of Subject.—3. The work of classifying bridges consists of three steps: (A) The determination of the capacity and rating of the bridges. (B) The determination in corresponding terms of the effect and rating of each type and size of engine or other equipment used, in order that the territorial operating limits of each class of equipment may be assigned. (C) The presentation of such data in form convenient for the operating personnel.

(A) Rating of Bridges

Plans and Records.—(a) Complete plans and records of each bridge shall be kept on file. Where no plans exist, field measurements shall be made and record plans prepared.

Bridge Sketches.—(b) For ready reference, a sketch, or line diagram, of each bridge shall be prepared.

Record of Bridge Material.—(c) The records shall show the material of which each bridge is composed. If necessary, the character of the material shall be determined from small specimens obtained in the field.

Assignment of Ratings.—(d) Each bridge shall be calculated on the basis of the rating rules and specification loading in effect. The strength of each member, including connections and other details, shall be determined and the capacity of the bridge ascertained. The bridge shall then be given a rating corresponding to the rating of its weakest member.

Filing of Calculations.—(e) The calculations shall be made in permanent form and filed for future reference.

Bridge Lists.—(f) Lists of all bridges shall be prepared, showing for each bridge the identifying number or name, location, lengths and number of spans, type, number of tracks carried, material of which composed, date built, and capacity.

(B) Rating of Equipment

Line Diagrams of Engines.—(a) A line diagram of each engine shall be obtained and filed for reference. Such diagram shall show the axle loads and wheel spacing of the engine and tender, and the distance between the tender and the following engine when double-headed.

Moments and Shears.—(b) The effect of each engine with its train load shall be ascertained by calculating the bending moments and shears. The calculation shall be based on an arrangement of loads similar to that used in the specifications; that is, if the specification loading provides for double-heading, the calculations shall be made on that basis.

Relation of Loads to Specification Loading.—(c) For each span length for which moments and shears are determined, the effect of the load in terms of the specification loading shall be obtained.

Engine Rating.—(d) The rating of the engine for operating purposes shall be expressed in terms of the engine for which the bridges are rated, and for that span length on which it produces its maximum effect.

List of Engine Ratings.—(e) The rating of an engine may be lower on a particular bridge than its rating for operating purposes if its rating for the span length of that bridge is lower than for the span length on which it produces its maximum effect. For that reason a list of engines should be prepared, giving for each engine its number, class, type, total weight, rating for operating purposes, and rating for each span length.

(C) Form of Presentation

Common Standard for Rating.—(a) Following the procedure outlined will result in assigning to each bridge and to each engine a rating based on a common standard.

Cooper Series as the Common Standard.—(b) The long use of the Cooper series as a standard of railroad bridge loading has already imparted to the operating personnel the significance of an operating condition involving engine loadings expressed in such terms. For this reason the Cooper series is adopted as the common standard.

Form for Use of Operating Department.—(c) The ratings of the various lines shall be shown by means of a diagrammatic map, or arranged geographically in a table, or both; the rating of each engine shall be listed.

Special Cases.—(d) Special conditions involving particular bridges on a line or the operation of special engines in certain territories, may be covered by the use of the asterisk or other symbols calling attention to exceptions to a general rule.

Rating of Foreign Engines.—(e) Frequently questions are raised in regard to the movement of foreign engines over a line. The approximate ratings of such engines can readily be determined, if similar engines have previously been rated.

Appendix C—Specifications for the Design of Turntables

Specifications Which Apply.—1. The General Specifications for Steel Railway Bridges, American Railway Engineering Association, 1920, with the current revisions thereof, and the Specifications for Movable Railway Bridges, American Railway Engineering Association, 1922, with the current revisions thereof, shall apply except as otherwise specified herein.

(I) General Features of Design

Types of Turntables.—2. Turntables shall be of the following kinds:

(a) Balanced
(b) Three-point-support
  (1) Continuous
  (2) Non-continuous

Tables preferably shall be of the deck plate girder type. Through plate girder, pony truss, and through truss types may be used.

Length.—3. The nominal length of the table is defined as the diameter of the pit; this diameter shall be a multiple of 10 ft.

The length shall be such that:

(a) For balanced tables, no part of the longest engine to be turned will project beyond the ends of the table when the engine, with tender empty, is balanced on the table.

(b) For three-point-support tables, no part of the longest engine to be turned will project beyond the ends of the table.

Clearances.—4. The clearances shall be not less than those shown on the diagram, Fig. 1. The height of rail shall be assumed as 6 in.

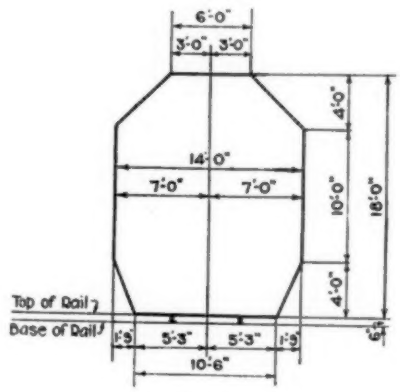


Fig. 1

Power Operation.—5. Tables 80 ft. or more in length preferably shall be power operated.

(II) Loads

Loads.—6. The table shall be proportioned for the following loads:

(a) The dead load.
(b) The live load without impact.
(c) The force required to rotate the table.

The stresses due to these loads and forces shall be shown separately on the stress sheets.

Live Loads for Design.—7. The minimum live load shall be that shown in Fig. 2 for the corresponding length of table, or that shown in Fig. 3. The loading that gives the larger stresses shall be used.

End floor beams, end trucks, and parts subject to similar reactions shall be proportioned for an axle load of 70,000 lb. in addition to the specified live load, and superimposed in the most effective position.

(III) Unit Stresses and Proportioning of Parts

Unit Stresses.—8. The unit stresses shall be as given in the Specifications named in Section 1, except for the parts which determine the deflection at the ends of balanced tables. Such parts shall be so proportioned that the unit stresses will not exceed the following:

	Pounds per sq. in
Axial tension	10,000
Axial compression	$9{,}500 - 30\frac{l}{r}$
l = length of member in inches. r = least radius of gyration of member in inches.	
Tension in extreme fibers of rolled shapes, built sections, and girders, net section	10,000
Tension in extreme fibers of pins	15,000
Shear in plate girder webs, gross section	6,500
Shear in power driven rivets and pins	7,500
Bearing on power driven rivets, pins, outstanding legs of stiffner angles, and other steel parts in contact	15,000

The above-mentioned values for shear and bearing shall be reduced 25 per cent for countersunk rivets.

Flange Areas.—9. The gross area of compression flanges of plate girders shall not less than the gross area of the tension flanges.

Deflection.—10. Balanced tables shall be so designed that the deflection due to live load will not exceed ½ in. for 80-ft. tables and 1¼ in. for 120-ft. tables. For tables of other lengths, the deflections shall be in proportion to those given.

In three-point-support tables, stiffness is not essential; rather a degree of flexibility is desirable.

(IV) Details of Design

Bracing.—11. Horizontal bracing shall be provided to permit turning the table by means of power applied at one end.

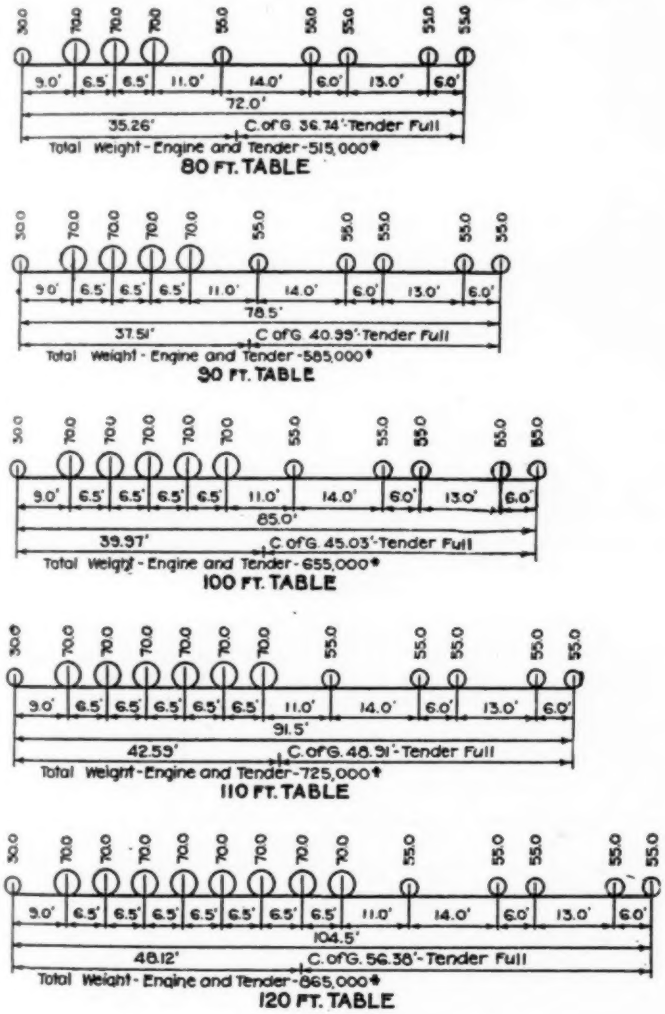


FIG. 2

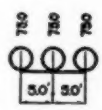


Fig. 3

There shall be both top and bottom lateral systems where practicable.

In balanced tables of the deck plate girder type, bracing to prevent warp is essential.

Inspection.—12. Tables shall be so designed as to facilitate inspection and permit making repairs.

Protection of Parts.—13. The center, center girders, and machinery shall be protected, preferably by metal housing, against the accumulation of water, cinders, and dirt.

(V) Center

Type.—14. The center may be of either the roller or the disc type, as determined by the Engineer.

General Features.—15. The point of application of the applied load shall be as nearly as practicable in the vertical through the center.

The entire center unit shall be as nearly dustproof and waterproof as practicable.

Adjustment.—16. Adjustment for height shall be provided.

Inspection.—17. The center shall be so designed as to be readily taken out and to facilitate taking apart for inspection, repairing and replacement of parts.

Materials.—18. Rotating parts shall be of special materials, and their rolling and sliding surfaces shall be highly finished.

Cast iron shall be used for minor parts only.

Special materials used in the center, which are not covered by the Specifications named in Section 1, shall be in accordance with the Specifications of the American Society for Testing Materials, with the current revisions thereof.

(VI) End Trucks

General Features.—19. The end trucks shall be of substantial construction, and braced to hold the axles of the wheels in radial lines over the circle-rail.

Each truck shall have at least two wheels at each main girder bearing.

The loads transmitted to the wheels shall be equalized.

The wheels shall not be flanged.

The wheels shall be of as large diameter as feasible.

On account of the impact of the live load, the elasticity of the parts immediately over the circle-rail shall be given consideration.

Wheels and Axles.—20. The wheels and axles may be cast integrally from open-hearth steel, or the wheels may be rolled from open-hearth or Bessemer steel and mounted on open-hearth steel axles under heavy pressure.

Bearing Boxes.—21. The bearing boxes shall be of cast steel, and provided with removable phosphor bronze bushings or bearings of other type, as determined by the Engineer.

Bearing boxes shall be compact, provided with lids which can be readily opened, and of such construction as will prevent the entrance of water and dirt.

(VII) Pit and Tracks

Circle-Rail.—22. The circle-rail shall be of a section not less than the heaviest standard rail used by the Railway Company, and preferably not less than 120 lb. per yd.

In the design, consideration shall be given to drainage, adjustment of elevation, and curvature of circle-rail.

The top of the circle-rail shall be in a horizontal plane throughout its entire length.

Radial Tracks.—23. The ends of the rails in the radial tracks shall be held securely in line and elevation. The top of rail of all radial tracks shall be at the same elevation as the top of rail on the end of the table with the end wheels bearing.

Radial track rails ending at the circle-wall shall be full length and anchored securely to prevent longitudinal movement.

Where wood supports are used for the ends of the rails in radial tracks, steel bearing plates shall be provided.

Rails on the Table.—24. The rails on the table shall be held in line and elevation and anchored to prevent longitudinal movement. Steel bearing plates shall be provided throughout.

The rails at the ends of the table shall be full length.

Inspection Pits.—25. Inspection pits in the circle-wall shall be provided.

Appendix E—Electric Welding of Connections in Steel Structures

During the past four years a large amount of structural steel has been electrically welded. Two methods of electric welding have been used—resistance welding and Arc welding.

Resistance Welding

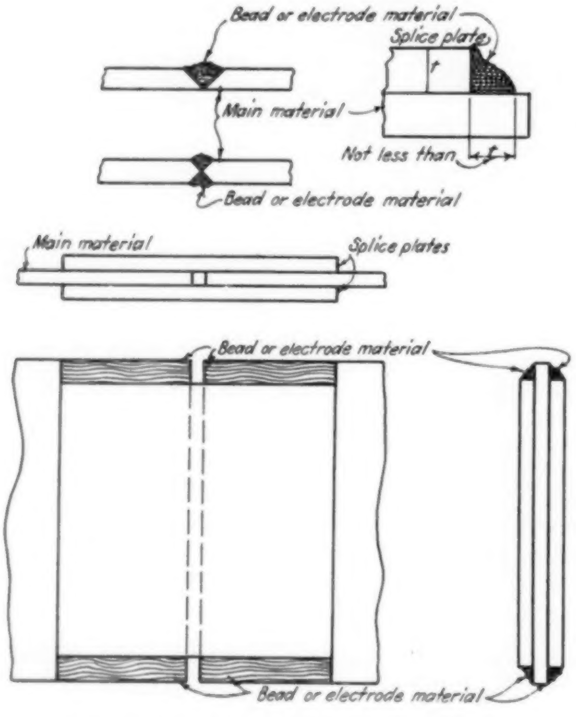
In resistance welding, the parts to be united are placed in contact, a current is passed through the parts, heating them at the contact surfaces, and the pieces are then pressed together. The heat and the pressure cause the parts in contact to be welded over a certain area. Several types of machines have been designed for welding of this kind; one type being somewhat similar to the ordinary power machine used in driving rivets.

The machine grips the parts to be welded between elec-

trodes which force the parts together under pressure. The current is then turned on and the material brought to a welding heat, which, together with the pressure, makes a spot weld uniting the adjacent parts of the material in the form of a small cylinder integral with the material of the connected parts. This is the method of spot welding. It has not been much used for steel structures.

Arc Welding

Up to the present time the method most used for welding structural steel has been arc welding. In this method an electric circuit is formed between the carbon or graphite electrode and the two pieces of steel which are to be welded by bringing them together. The arc is then formed by withdrawing the electrode a short distance from the steel. This method can be simplified by using the welding wire or rod as one electrode, the wire or rod taking the place of the carbon or graphite electrode. In



Samples of Splices—Electric Arc Welds

this case, the welding wire or rod melts and is fused with the molten steel of the parts to be welded.

Good results have been obtained in arc welding of structural steel for the various kinds of structures included in the classes mentioned above. Pressure tanks are very largely being constructed by arc welding, this method being found more satisfactory than riveting. One ship has been constructed by the use of arc welding throughout and has been in service for at least three years. The results which can be obtained by arc welding are very largely dependent upon the skill of the welder, and this work should be performed only by skilled operators. The art has, however, progressed sufficiently for us to know what conditions are necessary to obtain satisfactory results, and when these conditions prevail and the work is done by a good welder, satisfactory welds should be obtained. Unfortunately, the strength of the weld cannot at the present time be positively determined by an inspector. However, an experienced man can determine in a general way, by inspection, whether or not the weld is a good one. The drawing shows an arc-welded joint.

The strength of the joint is dependent upon the area of the bead and the strength of the welding material. Tests indicate that this welding material has an average ultimate strength in shear of about 36,000 lb. per sq. in. A safe working stress would therefore be about 9,000 lb. per sq. in.

It is quite evident that sufficient progress in the welding of steel structures has not yet been made to justify the American Railway Engineering Association in taking any action thereon at the present time. It probably is advisable for this committee to keep in touch with the experiments that are being and will be made, so that the association may be kept informed of developments in the art.

Appendix F—Investigations and Tests of I-Beams

The sub-committee has given much study to the method of procedure in making the tests. A carefully developed program of tests has been prepared, subject to such modification as the results of preliminary tests may show to be desirable. It has been decided to proceed as soon as materials can be obtained to carry out tests on sets of 15 ft. and 25 ft. lengths. There are to be three sets of each length, consisting of 1, 2 and 3 beams, respectively.

Appendix G—Column Tests

The Committee has had some correspondence and interviews with the Bureau of Standards, with a view to carrying to completion the series of tests which the bureau had under way for the committee a few years ago, which tests were interrupted in 1916. No definite schedule has yet been arranged. The bureau has suggested an extensive program of column research, indicating a desire for co-operation among different associations interested in the results. It is expected that a satisfactory program will soon be arranged with the bureau.

Discussion

(The report was presented by Chairman Dalstrom, *whose motion that Appendix A covering Revision of the Manual, and Appendix B, on the Classification of Bridges be adopted for inclusion in the Manual was carried. Appendix C, covering Specifications for the Design of Turntables was received as information.*)

Mr. Dalstrom: Since the committee submitted the report recommending that for Steel Highway Bridges, in Appendix D, be adopted for publication in the Manual, two conditions have arisen which affect this recommendation. One is that the changes made in the A.R.E.A. railway specifications affecting the specifications for material should be incorporated in the specifications for steel highway bridges. The other is that a committee consisting of representatives from the A.R.E.A., the A.S.C.E., and the Association of State Highway Officials, has held a conference on features of the specifications, which it considers can be made the same in all specifications. The chairman of the sub-committee on these specifications has indicated that it would be inadvisable at this time to have these specifications printed in the Manual since they are likely to be revised to some extent during 1924. I would recommend that the specifications for steel highway bridges be received as information.

President Lee: If there is no objection it will be so ordered.

(Appendices E, F and G on Electric Welding, Tests of I-Beams and Column Tests were then accepted as progress reports.)

G. A. Mountain (Canadian Railway Commission): Does the committee expect to make the standards for highway bridges the same in every state in connection with this specification? We have nine provinces and each one seems to have a different specification for high-

way bridges. I refer to highway bridges with railway bridges over them. The Canadian Engineering Standards include a highway bridge specification which our railway commission has approved, and yet I have some trouble in getting the provincial engineers to fall into line.

Mr. Dalstrom. It was not the idea of the committee that the specifications would be universally adopted throughout the states. The primary object is to prepare specifications which the railways can adopt and can use in dealing with the state and municipal authorities in constructing highway bridges in which the railways are interested.

(The Committee was excused with the thanks of the Association.)

Report of the Committee on Electricity

The Committee on Electricity presented brief progress reports on a considerable number of assignments, many of which involve co-operation with other organizations, and which will be fruitful of valuable results in the future. The specific matter presented was primarily in the nature of specifications, in either tentative or in final form, for adoption as standard for inclusion in the Manual. These included specifications for porcelain insulators and for overhead transmission lines, rules for the protection of oil supplies from stray currents and revised tables of working clearances for third rails and overhead working conductors. E. B. Katte, chief engineer electric traction, New York Central, has been chairman of this committee for 8 years and has been a member for the past 13 years.

E. B. Katte
Chairman

The committee on Electricity presented reports on 12 different assignments as follows: Brief statements of progress were presented on electrical interference (Appendix B); water power (Appendix C); electrolysis (Appendix D); co-operation with the Bureau of Standards (Appendix E); collaboration with the Committee on Economics of Railway Location (Appendix G); wire crossing specifications (Appendix H); standardization of adhesive and rubber tapes (Appendix I).

In an Appendix F the committee presented specifications for overhead transmissions and distribution line construction; in Appendix J, specifications for porcelain insulators, knife and snap switches, etc., which are reproduced below. In an Appendix K, the committee presented revised tables showing third rail and overhead working conductor clearances. A supplementary report covered recommended practice for protecting oil sidings.

The recommendations of the committee were that the specifications in Appendix F and Appendix J be tentatively accepted as recommended practice pending final revision after the first year of their use, that the revised tables in Appendix K be inserted in the Manual, and that the report on oil sidings be inserted in the Manual to supersede similar rules adopted in 1923.

Committee: E. B. Katte (N. Y. C.), chairman; D. J. Brumley (I. C.), vice-chairman; H. M. Bassett (N. Y. C.), R. D. Coombs (Con. Engr.), J. H. Davis (B. & O.), W. J. Eck (Sou.), F. D. Hall (B. & M.), G. W. Kittredge (N. Y. C.), W. L. Morse (N. Y. C.), A. E. Owen (C. R. R. of N. J.), E. B. Temple (Penna.), H. M. Warren (D L. & W.), S. Withington (N. Y. N. H. & H.), R. Beeuwkes (C. M. & St. P.), J. C. Davidson (N. & W.), J. V. B. Duer (Penna.), G. Eisenhauer (Erie), J. L. Harper (Niagara Jct.), H. K. Lowrey (C. R. I. & P.), R. J. Needham (C. N. R.), Martin Schreiber (Pub. Serv. Ry.), W. M. Vandersluis (I. C.), L. S. Wells (L. I.).

Appendix J—Specifications for Porcelain Insulators for Railroad Supply Lines

General

1. **Scope.**—The purpose of these specifications is to describe porcelain insulators suitable to support and insulate wires for the transmission and distribution of electricity for railroad use.

2. **Design.**—The form shall be such that the insulator will carry successfully the electrical and mechanical stresses that will be imposed upon it in service. It shall be so designed as to permit expansion and contraction due to temperature changes without cracking and so that it will not interfere unnecessarily with the cleaning action of the rain and have a suitable groove adequate for the tie and line wires intended, which shall be smooth, free from sand and sharp edges.

Insulators shall be designed that their flashover voltage is not more than 75 per cent of their puncture voltage as described in Section 23.

Materials, Properties and Uses

3. **Porcelain.**—Insulators shall be made by the wet process. The porcelain shall be dense, fine grained, homogeneous, non-absorptive, strong, tough, without voids or air pockets, laminations, metallic substances or internal stresses. It shall have been burned to complete vitrification, but not over-fired. It shall be true to shape with smooth surfaces, except where sanded for cementing.

4. **Glaze.**—The porcelain shall be glazed with a smooth, hard, continuous firmly adherent coating, uniform in thickness and of good color, which shall have the same thermal expansion as the porcelain body. The glaze shall be impervious to moisture, not affected by sudden changes in temperature or by ozone, locomotive gases, acid or alkali dust.

5. **Sanding.**—The surfaces to be cemented shall be sanded with a porcelain sand of a size best adapted to the kind and dimensions of the insulator. It shall form an evenly distributed layer firmly vitrified to the shell.

6. **Hardware.**—Metal pins and studs shall be drop forged or cut from rolled stock or high grade malleable iron or annealed cast steel. Caps and clamps shall be of high grade malleable iron or pressed, forged or annealed cast steel. Cotter pins shall be of brass or non-corrodible metal.

7. **Galvanizing.**—The ferrous hardware shall be hot galvanized in accordance with the American Railway Engineering Association specifications for galvanizing.

Inspection

8. **Factory Inspection.**—The purchaser reserves the right to inspect at the works all the processes entering into the manufacture of the insulators and the inspector will reject any part or parts, or any finished product which does not comply with these specifications.

Assembly and Tests

9. **Testing the Individual Parts.**—The individual shells of multipart insulators shall be tested for dielectric strength

before assembly. The character of the testing equipment, method of measuring voltage, mounting of insulators and application of the testing current shall conform to the Standards of the American Institute of Electrical Engineers.

(a) **Preliminary Test.—PinType:** Before assembly, all shells shall be subjected to vigorous dry flashover potential at normal frequency 25 to 60 cycles for 3 min. If more than 5 per cent fail, the lot shall be retested. If on retest more than 3 per cent fail, the lot shall be rejected.

(b) **Preliminary Test**—Suspension Type: Before assembly, all shells shall be subjected to vigorous dry flashover potential at normal frequency 25 to 60 cycles for 5 min. If any shell fails during the fourth or fifth minute of the test, the test shall be continued until no shell fails during the last two minutes of test. The excess time is based on the testing of quantities up to 100 at one time. For quantities greater than 100, the excess time after the last failure may be less than two minutes by agreement between manufacturer and purchaser. If more than 5 per cent fails the lot may be retested. If on retesting more than 3 per cent fails the lot shall be rejected.

10.—Assembly.—The several shells of a cemented insulator with its metal parts shall be cemented together with the best quality of neat Portland cement carefully mixed. There shall be suitable provision for expansion of the cement after the assembly. This requires the use of elastic media, temporary paper collars or similar devices. The cement shall be kept moist for not less than 48 hours immediately after the assembly. Suspension type insulators shall be kept in a steam treating chamber at not less than 130 deg F. for not less than 12 hours, or at not less than 110 deg F. for 48 hours immediately after the assembly. When required, pin type insulators in which the pins are mounted at the factory shall be subjected to the same treatment.

Testing Completed Units

11. Pin Insulators.—After complete assembly and cleaning, all insulators shall be tested in groups. The character of the testing equipment, method of measuring voltage, mounting and application of the testing current shall conform to the Standards of the American Institute of Electrical Engineers.

Pin Fit.—Ten per cent of insulators which are to be mounted on threaded pins shall be tested for pin fit. They shall be screwed to a seat, then unscrewed two full turns without releasing from the pin. If any undersized or oversized pin holes are found, the entire lot shall be tested and all poor fits rejected.

Final Test.—Before assembly, the insulators, shall be subjected to dry flashover test for two minutes. Voltages shall be such that insulators shall flashover occasionally. Insulators failing by puncture under this test shall be rejected. After assembly, all units shall be subjected to dry flashover test at normal frequency 25 to 60 cycles for three minutes. Voltages shall be such that insulators shall flashover occasionally. All units failing by puncture under this test shall be rejected.

12. Suspension Type Insulators.—(a) **Mechanical Test**—Suspension insulators shall be tested in tension with a loading of 40 per cent of the specified ultimate strength.

(b) **Electrical Test.**—Subsequent to the mechanical test, each insulator unit shall be given as rigorous a test as the final electrical test provided for pin insulators.

Definitions

13. Pin Insulator.—A "Pin Insulator" is a complete insulator, consisting of one insulating member or an assembly of such members without tie wires, clamps, thimbles or other accessories, the whole being of such construction that when mounted on an insulator pin, it will afford insulation and mechanical support to the conductor.

14. Suspension Insulator.—A "Suspension Insulator" consists of a porcelain body with its means of suspension in place.

15. Shell.—A "Shell" is a single insulating member of porcelain without cement, pin, cap, stud or other attachment: a component part of a multipart insulator.

16. Insulator Unit.—An "Insulator Unit" is a single insulator with or without its pin or thimble if of pin type, but with its means of attachment if of the suspension type.

17.. String.—A "String" is the total number of suspension insulators connected in series as required at one point of support.

18. Sanded Surface.—A "Sanded Surface" is any surface of a shell whcih is covered with a sand-like coating to facilitate the adhesion of cement.

19. Ultimate Mechanical Strength of Insulators.—The "Ultimate Mechanical Strength" is the loading in pounds at which the insulator will fail mechanically when subjected to tensil stress.

20. Ultimate Combined Mechanical and Electrical Strength.—The "Ultimate Combined Mechanical and Electrical Strength" is the loading in pounds at which the unit fails to perform its function as an insulator.

21. Dry Flashover Voltage.—"Dry Flashover Voltage" is that at which the air surrounding a clean dry insulator or shell breaks down between electrodes with the formation of a sustained arc at 60 cycles per second. Test to be made as required by the Standards of the American Institute of Electrical Engineers.

22. Wet Flashover Voltage.—"Wet Flashover Voltage" is that at which the air surrounding a clean insulator or shell under "A. I. E. E. Standard Spray Conditions" breaks down between electrodes with the formation of a sustained arc at 60 cycles per second. Tests to be made as required by the Standards of the A. I. E. E.

23. Puncture Voltage.—"Puncture Voltage" is that at which an insulator or shell is electrically punctured when immersed in oil and subjected to a gradually increasing voltage, as required by the Standards of the A. I. E. E.

Appendix K—Clearances for Third Rail and Overhead Working Conductor

The committee communicated with the officers of each electrified steam railroad and, based on the information thus directly received, it revised the Clearance Tables and brought them up to date.

The committee recommended that these tables be accepted as information and published in the Proceedings and substituted for similar tables now in the Manual.

Rules for Recommended Practice Relative to the Protection of Oil Sidings from Danger Due to Stray Currents

On side tracks or yards where inflammable liquids having a flash point of 30 deg. Fahr. or below are loaded or unloaded from tank cars the following precautions are recommended:

(A) For Side Tracks Not Electrically Equipped Where Stray Electrical Currents Exist

1(a) The rails of such side tracks or yards should be electrically separated from all other track rails by the installation of insulating rail joints of approved type.

2(a) Permanent electrical connection of not less than No. O copper should be made between the rails on which the tank car stands and piping system used in connection with the handling of inflammable liquids. This connection may be accomplished in two ways: the rails may be bonded by means of standard rail bonds, No. O connection being made between both ends of the track section and the permanent oil pipes; or a similar connection between each rail on which the cars are spotted and the permanent oil pipes.

3(a) Where considerable amount of stray current exists pipe and metallic structures should be electrically inter-connected and grounded in addition to the above connections to the rails; and in addition to the permanent connection, a temporary electrical connection of No. O flexible copper strand from each oil pipe outlet to each car tank should be made. These temporary connections should be attached to the pipes. These connections, as well as others to the car tank, should be by approved attachment plugs or clamps as prescribed in the National Electrical Code. These connections should be made before unloading or loading is started and should not be removed until after loading or unloading is completed. Connections should not be made between the tank cars, racks and oil pipe outlets when a car or locomotive is standing over and bridging the insulated rail joints of the sidings, and cars standing on tracks within the insulated joints should be separated from adjacent cars standing outside the section.

4(a) All bond connections should be carefully inspected frequently to insure th:t they are in proper condition.

(B) For Side Tracks Electrically Equipped

Where side tracks are electrically equipped the following recommendations in addition to those contained in paragraphs 1(a), 2(a), 3(a) and 4(a) must be complied with:

1(b) If it is necessary that tracks in electrified territory be equipped with trolley or third-rail, insulating track joints should be installed as in paragraph 1(a), between the loading or unloading location and the main tracks or other parts of the siding

In this case, an adequate return conductor, independent of the rails, should be installed from the rail at the loading or unloading location to a switch which short-circuits the insulating joints. This switch should be interlocked with the switch controlling the supply of power. The trolley or third rail should normally be dead and grounded and the negative return switch open.

2(b) Under special conditions where the provisions of paragraph 1(b) are impracticable, permanent and temporary connections referred to may be omitted, in which case discharge to or from tank cars should be through non-metallic hose of sufficient length to prevent metallic contact between the pipes and car or rails.

Discussion

(In the absence of Chairman Katte and Vice-Chairman Brumley, A. E. Owen (C. R. R. of N. J.) presented the recommended revisions of the Manual, *which were adopted.*)

J. C. Davidson (N. & W.): The president of the American Railway Association accepted the invitation of Mr. Gherardi, vice-president of the American Telephone & Telegraph Company, to send six representatives to co-operate with the telephone and telegraph companies, the National Electric Light Association and the American Electric Railway Engineering Association in the formation of an American Committee on Inductive Co-ordination. In line with this, representatives were appointed from the Construction and Maintenance section, the Electrical section, the Telegraph and Telephone section and the Signal section. The first meeting of this joint committee was held in New York on November 27, 1923. The recommendation is that the subject be continued.

(The recommendations of the sub-committees on water power, electrolysis and co-operation with the U. S. Bureau of Standards were presented in order and adopted without discussion, followed by the presentation of the report on overhead transmission lines.)

Maurice Coburn (Penna.): There is one point that I wanted to call to the attention of the committee on overhead transmission lines. The statement is made that structural steel shall conform to the Specifications A-9, relative to Structural Steel for Buildings, as adopted by the American Society for Testing Material. Our structural steel specifications for steel buildings are not yet ready, but I have been wondering whether they could use for that our specifications for structural steel for bridges. We ought to use one of our own specifications if possible.

President Lee: As I understand it, this specification is tentative. It is proposed to consider the specification further and no doubt that particular item will be dealt with during the coming year.

(The reports on the economics of railway location and on wire crossing specifications were then presented and adopted, followed by the presentation of the report on adhesive and rubber tapes.)

C. W. Baldridge (A. T. & S. F.): I wonder whether it is necessary to carry a recommendation instructing the committee to consider this question for revision. It seems to me there is something in the Manual at present on this subject.

President Lee: As I understand it the recommendation of the committee is simply that it continue the work and later make its definite recommendation for inclusion of matter in the Manual.

(The recommendations of this committee were adopted without further discussion, as were also the subsequent reports remaining on insulators and the protection of oil sidings from stray currents.)

J. L. Campbell (E. P. & S. W.): I desire to commend the committee upon the co-operation that it secured with other interests interested in the subject on oil sidings whereby the unanimous agreement has been reached with the result that when these specifications are offered they will not be met with the objection by outside interests that they are not satisfactory. The work that this committee has done in this particular case is an excellent example, which I hope will be noted by the other committees of the association when they are dealing with subjects in which other people are interested.

(The committee was excused with the thanks of the association.)

Report of the Committee on Roadway

The report of the Committee on Roadway offers an excellent illustration of the application of scientific methods to railway construction and maintenance. This comment applies particularly to the report on the Economics of Filling Bridge Openings and the report on Deferred Construction Costs. The first is of utmost importance in determining the character of construction to be adopted in the rebuilding of railroads to meet the requirements of rapidly growing traffic. The latter has a vital relation to a fundamental problem arising in federal valuation. Another feature of the report is a discussion of measures to prevent the blocking of culverts. This is the second year that C. M. McVay has served as chairman and the ninth year that he has been a member of the Committee on Roadway.

C. M. McVay
Chairman

The committee recommended the following action on its report:

1. That the proposed form in Appendix A be substituted for the present form in the Manual.
2. That Appendix B be approved as recommended practice and published in the Manual.
3. That Appendix C be received as information.
4. That Appendix D be received as information.
5. That Appendix E be received as information.
6. That proposed form in Appendix F be approved and inserted in the Manual.

Committee: C. M. McVay (N. Y. C.), chairman; J. C. Wrenshall (P. & R.), vice-chairman; J. B. Akers (Sou.), R. G. Alysworth (C. B. & Q.), A. E. Botts (C. & O.), A. S. Butter-

worth (M. S. B. & P.), E. J. Bayer (C. C. C. & St. L.), H. W. Brown (Penna), G. S. Crites (B. & O.), C. C. Cunningham (C. R. I. & P.), C. A. Daley, A. Harvey (M. K. T.), H. Hawgood (Con. Engr.), E. G. Hewson (C. N. R.), J. R. Hoagland (C. & A.), H. M. Hockman (T. St. L. & W.), W. M. Jaekle (S. P.), W. W. Kelly (A. T. & S. F.), O. V. Parsons (N. & W.), W. H. Penfield (C. M. & St. P.), R. B. Robinson (U. P.), H. J. Shaw (Penna), G. L. Sitton (Sou.), H. E. Tyrrell (Sou.), C. E. Weaver (C. of Ga.), W. H. Woodbury (D. & I. R.).

Appendix A—Revision of Manual

Present Form	Proposed Form
Shoulder—That portion of the sub-grade laying between the ballast covered portion and the ditch in cuts and the top of slope on embankments.	Roadbed Shoulder — That portion of the sub-grade lying between the ballast covered portion and the ditch in cuts and the top of slope on embankments.

The above is contingent on the Ballast committee changing its title "Shoulder" to "Ballast Shoulder."

Appendix B—(2) Economics of Filling Bridge Openings

The Committee presented a report at the twenty-third Annual Convention dealing with various methods of filling bridge openings as practised in different parts of this country. It is proposed in this report to continue the subject from the standpoint of justification of expenditures, eliminating reference to the physical character of the work, which was covered two years ago. It became evident as the investigation progressed that before it could be determined whether the replacement indicated the filling of the bridge opening or some other method of replacement, a careful analysis of all the component elements of cost must be made. In many cases no doubt methods other than filling may be found preferable, but the general principles laid down in this report are applicable to any bridge replacement problem. It is impossible to restrict it to the question of bridge filling alone. Obviously, where a more permanent type of construction costs less than a renewal in kind, there can be no question as to the economy of making the improvement. Replacement or renewal of bridges and trestles takes place for one or more of the following reasons:

(1) Obsolesence (requirements of heavier traffic)
(2) Deterioration (natural decay)
(3) Accident (fire, wreck or flood, etc.)

The problem then resolves itself into whether it is more economical to renew in kind or to replace with a more permanent type of structure at a greater investment outlay.

The question of full maturity should also be considered—care should be taken that the full life of the structure is obtained; as for instance, a bridge that may last one or two years longer than by an annual expenditure of an amount less than the interest and maintenance charges of new structure per year, should not be renewed or replaced until expiration of its full service life. The element of safety, being paramount, must be given consideration in all cases. It is recommended that this report as well as the first portion thereof presented to the convention of 1922, be accepted and printed in the Manual.

As a general outline by which the relationships between the various elements of cost may be analyzed, the following method of procedure is recommended (see tabulation of examples):

Col. 1—Identification of structure.
Col. 2—Grade line length of structure (description optional).
Col. 3—Established life cycle in years; usually obtainable from the major renewals. In other cases where the renewals are continuous this period may be arrived at approximately by dividing the cost of a complete new structure in kind by the average annual costs of piecemeal structural renewals.
Col. 4—Total equated maintenance costs for a representative period of years (obtained from maintenance charges plus interest at predetermined rate on cost of renewal at present prices.) Material and labor costs to be adjusted to the year in question in the determination of the amount in this column. As an example, take the case of Bridge 79 in the table. At the end of the second cycle there are contained two renewals of $722 each, interest charges for fourteen years, or $43.32 annually, being six per cent on $722—adjusted original investment $606.48, and $540.52, which is the sum of the adjusted repairs and maintenance costs for the 14 years. This gives a grand total of $2,591 ($722 plus—plus $722 plus $606.48 plus $540.52). (The item of $540.52 should contain all costs for insurance, labor, material and interest depreciation and repairs on all tools and equipment.)
Col. 5—Average annual cost to maintain existing structure. By continuing the same example the $2,591 is divided by 14 (life of two cycles) resulting in $185.
Col. 6—Justifiable expenditure in replacement. (Obtained by capitalizing at same predetermined interest rate average annual charges to maintain existing structure.) ($185 x $16.66 plus $3,085.)

Analysis of Costs—Present and Proposed Structures

Structure Number	Existing Conditions (Renewal)								Proposed Conditions (Replacement)							Determining Factor		Accounting		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20
	Center Line Length and Description	Established Life Cycle	Equated Maintenance Costs	Annual Cost of Maintenance	Justifiable Expenditure on a 6 Per Cent Basis*	Cost of Renewing in Kind	Cost of Maintaining Traffic During Renewal	Total Cost of Renewal in Kind	Type of Proposed Structure	Cost of Proposed New Structure	Cost of Maintaining Traffic During Replacement	Total Cost to Replace	Annual Interest Cost	New Annual Maintenance Charges	Annual Cost of Proposed Structure	Annual Gain or Loss by Replacement		Charges to Operating Expenses		Charged to Investment "A" or "B", or Both
																+	−	Maintaining Traffic During Construction	Property Retired and Replaced	
79	42′	7.0	2591.00	185.00	3085.00	640.00	82.00	722.00	Double 6′0″x10′0″ Concrete Box	1799.00	189.00	1988.00	119.00	8.00	127.00	58.00	......	180.00	640.00	1159.00
82	76′	9.2	1937.00	138.00	2300.00	1140.00	135.00	1275.00	Double 8′0″x8′0″ Concrete Box	3685.00	430.00	4115.00	246.00	15.00	261.00	......	123.00	430.00	1140.00	2545.00
75	112′	19.6	1385.00	99.00	1650.00	1758.00	180.00	1938.00	80′ Plate Girder	12850.00	80.00	12930.00	776.00	60.00	836.00	......	737.00	80.00	1858.00	10992.00

*Each railroad to use the current rate of interest at the time calculation is made.

Col 7—Cost of renewing existing structure in kind (Engineer's estimate).
Col. 8—Cost of maintaining traffic during renewal (Engineer's estimate).
Col. 9—Total cost to renew in kind (sum of $640 plus $82 =$722).
Col. 10—Type of proposed new structure.
Col. 11—Cost of proposed new structure (Engineer's estimate).
Col. 12—Cost of maintaining traffic during replacement (Engineer's estimate).
Col. 13—Total cost of replacement ($1,799 plus $189 = $1,988).
Col. 14—Annual interest at same rate on total cost of replacement ($1,988 at six per cent = $119).
Col. 15—New annual maintenance charges (Annual cost to maintain proposed new structure) (Engineer's estimate).
Col. 16—Annual cost of proposed structure (Computed for proposed structure on the same basis as Col. 5 is computed for existing structure ($119 plus $8 = $127).
Col. 17—Annual gain or loss by replacement. Difference between $127 in Col. 16 and $185 in Col. 5, which shows a net annual saving of $58 by providing new structure over the old structure. Where the result shows a loss or deficit, consideration should be given to operating advantages which may offset loss by replacement.
Cols. 18 and 19—Charges to Operating expenses for
(a) Maintaining traffic during construction—taken from Col. 12; this is always an operating charge.
(b) Property retired and replaced—taken from Col. 7; this is usually an operating charge, but under special circumstances may be a charge to profit and loss. (See page 13, Sec. 7, I. C. C. classification of investment.)
Col. 20—Charges to Investment (Additions or Betterment, or both). This is the net additional investment—difference between Col. 19 and Col. 11 or $1,799—$640 = $1,159.
Cols. 18, 19 and 20 show the accounting distribution of the entire cost of replacement.

Appendix C—The Effect of Heavier Power and Increased Tonnage Upon Roadbed Previously Stable

In order to get information on the effect of heavier power and increased tonnage upon roadbed previously stable, the committee addressed a letter of inquiry to various railway officials in the different sections of the country and from the answers received, it seems that in practically all sections of the country some trouble is being experienced with roadbed previously stable. This trouble has started during the last decade, or since the advent of the present heavy locomotives and higher capacity cars. Some of the larger coal roads, especially, are now handling cars with an axle load at least approximating that of the locomotives. The principal effect noted has been the deformation of the roadbed or ground adjacent thereto, and the development of water pockets in both cuts and fills. This, of course, results in irregularities in the line and surface of the track, with consequent abnormal strains on ties, rail, fastenings, etc.

The following remedies are suggested:

1. Strengthening the Roadbed by Better Drainage

The subgrade should be kept as free from water as possible. In many cases, sewer pipe subdrainage has been successful. Intercepting ditches also will aid in keeping the water away from the subgrade. Local conditions determine what method seems advisable for improvement of drainage.

2. Strengthening the Roadbed by Widening Same

This will insure a better bearing on the ground under the embankments, and help to stabilize the fills. It will provide more ditching room in cuts and permit better ballast drainage, also a greater area of saturation for rainfall.

3. Help the Roadbed to Function Properly by a Better Distribution of the Load.

This can be accomplished as follows:
(a) Increase the depth and quality of ballast.
(b) Increase the number of cross-ties per rail length.
(c) Increase the weight of rail.
(a) Pay more attention to the bolting and surfacing (tamping) of tracks.

Problems of caring for situations of this general nature are local, being especially acute in locations where the roadbed is constructed of, or on material easily made unstable by wet weather. The extent to which remedies can be applied is often limited by the amount of expenditure. It should always be borne in mind that it costs much money in labor to properly protect operation over unstable points in the roadbed (and track) and a comparatively small amount spent for remedy will, as a rule, earn good returns.

Appendix D—Deferred Construction Costs Chargeable to Track Laying and Surfacing

The data and results submitted herein are the results of the research by the Special Valuation Committee.

A detailed study was made of 29 lines or portions of line. Tabulation "A" shows the lines, location, and mileage and the results of the investigation. It seems proven that greater costs are incurred in track maintenance (labor expended in alining, surfacing, gaging and shimming tracks, in tightening track bolts and track

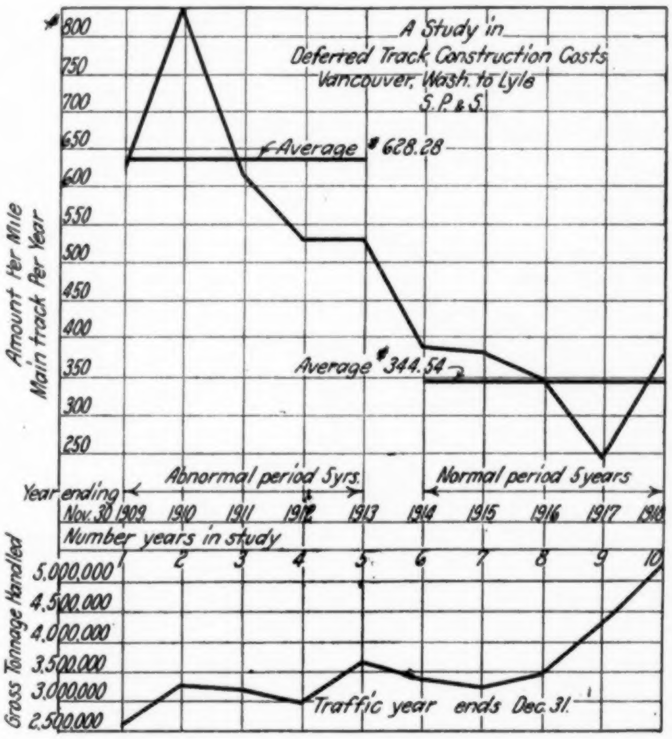


Diagram 1

spikes) during the period of operation immediately following construction than during the period after the roadbed has become seasoned. The costs determined by this investigation are specifically seasoning costs.

In 26 cases comparisons are made on the same line between the early or abnormal period of maintenance requirements, immediately following the completion of the primary construction, and the subsequent period of normal requirements. These may be termed self-contained studies. In three cases direct comparisons were made between old and new lines of practically identical characteristics. Each method produces very definite and similar results.

Diagram 1 shows the first line listed in the tabulation. It is the line of the Spokane, Portland & Seattle from Vancouver, Wash., to Lyle. This is a self-contained study and covers a period of ten years commencing with the first year of operation. The first five years are the period of early operation during which the costs of track maintenance, as already herein defined, averaged $628.28 per mile of main track per year.

The second period of five years is considered as normal and the track maintenance costs averaged $344.54 per mile of main track per year. This produces a total difference of $1,419 per mile of main track ($628.28 minus $344.54 multiplied by five years). This sum represents that part of the cost to the railroad of keeping this track in line and surface during the seasoning period which is caused solely by the seasoning process, before

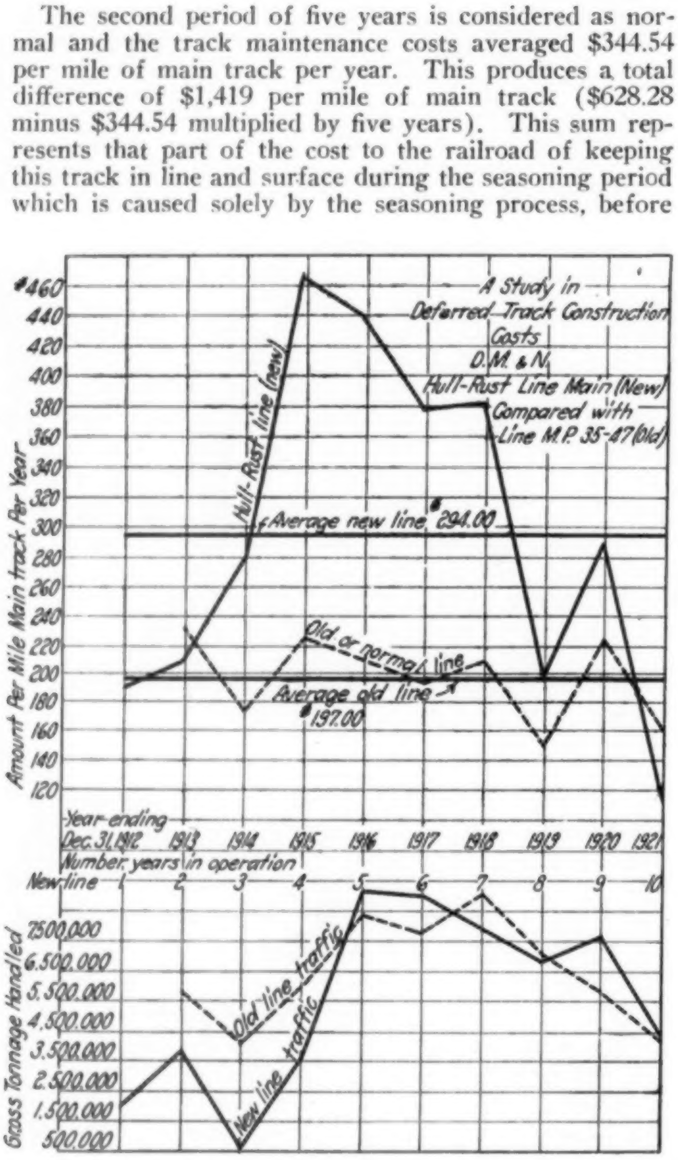


Diagram 2

the effect of changes in volume of traffic and other influences are eliminated. This $1,419 is the unadjusted "Deferred Track Construction Costs" per mile of main track.

Diagram 2 is a comparison between two similar lines, but otherwise is in every way similar to Diagram 1. The sum developed by this study is $970 per mile of main track.

The expression "Deferred" does not imply that these costs should have been incurred during the construction period prior to the commencement of operation. These are construction costs which must inevitably accrue after operation begins. It is not optional with the railroad whether or not these costs be incurred. They are costs of producing a seasoned railroad. They are not recurrent and, therefore, should be a capital charge.

The studies indicate that the seasoning period (in so far as this track work is involved) has an average length of a little over five years. The method of measurement selected is to express these costs as a percentage of the normal annual charges to Account 220, after the exclusion therefrom of wholesale renewals of ballast or rail or other unusual program work. For high quality high speed lines the relationship to the annual normal maintenance costs in Account 220 would be the same as for the lightly maintained branch line. The high speed line would have a large normal annual maintenance cost per mile of main track and the data shows that such lines have proportionately high costs of seasoning. Similarly a low class lightly maintained branch line for which the normal maintenance charges are low would have relatively low seasoning costs.

In the method of measure selected, i. e., normal annual charges to Account 220, is found a true test of comparability as between railroads and as between the seasoning period and the normal period. What affects one affects the other excepting, of course, to a different degree. This unit reflects the demands of traffic, of policy, of climate, and of the other physical characteristics.

In developing the final percentage representing Deferred Track Construction Costs, it was necessary to make an adjustment to eliminate the effect of changes in volume of traffice as between the two periods under observation. To this end the formula developed by the

Tabulation "A"

Relation of Deferred Track Construction Costs to Average Annual Normal Maintenance Charges to Account 220

Index No.	Carrier	Ballasted or Unballasted Track	Miles Main Track	Total Deferred Track Construction Costs Per Mile Main Track	Average Annual Maintenance Charges to Account 220 Per Mile Main Track During Normal Period	Percentage Col. 7 is of Col. 8
1	S. P. & S.	Ballasted	74.90	$1,419	$ 487	291.
2	D. M. & N.	Ballasted	24.00	970	366	265.
3	U. P.	Ballasted	25.24	689	140	492.
4	O. W. R. R. & N.	Ballasted	26.30	890	443	201.
5	C. & S.	Ballasted	92.98	363	226	161.
6	U. P.	Ballasted	23.22	2,421	503	481.
7	U. P.	Ballasted	17.05	705	346	204.
8	M. St. P. & S. S. M.	Ballasted	72.16	428	261	164.
9	C. R. I. & P.	Line has not	attained	seasoned	condition.	
10	St. L. & S. W.	Ballasted	28.09	735	172	427.
11	O. W. R. R. & N.	Ballasted	14.71	337	328	103.
12	O. S. L.	Unballasted	45.785	148	128	116.
13	O. S. L.	Unballasted	72.853	153	115	123.
14	D. & I. R.	Ballasted	7.60	783	366	214.
15	U. P.	Ballasted	32.26	494	441	112.
16	O. W. R. R. & N.	Ballasted	57.01	490	409	120.
17	C. & S.	Ballasted	29.00	190	158	126.
18	O. W. R. R. & N.	Ballasted	17.97	438	148	296.
19	D. W. & P.	Ball—sted	65.15	359	256	140.
20	D. & I. R.	Ballasted	7.60	857	357	240.
21	U. P.	Ballasted	27.45	308	126	244.
22	U. P.	Unballasted	40.32	225	127	177.
23	O. W. R. R. & N.	Ballasted	100.85	290	179	162.
24	S. P.	Ballasted	8.05	1,295	264	491.
25	A. T. & S. F.	Unballasted	70.18	260	98	265.
26	A. T. & S. F.	Ballasted	12.80	861	309	279.
27	O. W. R. R. & N.	Ballasted	11.73	1,822	417	437.
28	A. T. & S. F.	Ballasted	11.00	586	132	444.
29	S. P.	Ballasted	11.904	608	154	395.
	Totals and averages		1028.162	$19,133	$7,456	....
	Simple average		....	683	266	256.61

United States Railroad Administration for measuring the difference in maintenance costs due to difference in use was adopted. Tabulation B gives the method of application.

This subject, that is, "A method for determination of proper allowances for maintenance of way expenses, due to increased use," is one of the subjects assigned to the Committee on Economies of Railroad Operation, and this part of the report may be considered tentative until the report of that committee is accepted. The Deferred Track Construction Costs are found to be 257 per cent of the normal annual charges to Account 220 before the elimination of the effect of traffic changes. The adjustment for the changes in volume of traffic increases this percentage to 317 per cent. The 23.645 per cent developed on tabulation B is applied to the 2.5661 per cent, and the result added produces the 317 per cent.

The Special Valuation Committee, hereinbefore referred to, after considering that the tie renewals are

heavier in the normal periods of maintenance than in the seasoning period, and considering that the adjustment for traffic is probably too low because of the projecting of the data derived from seasoned track over unseasoned track, is of the opinion that the Deferred Track Construction Costs are not less than 375 per cent of the normal annual charges in Account 220. It should be noted that the 375 per cent, although applied to the normal charges of Account 220 for one year, produces the Deferred Track Construction Costs for the entire seasoning period averaging a little over five years.

TABULATION "B"

Deferred Track Construction Costs—Statement Showing Derivation of Adjustment to Eliminate Effect of Traffic Changes

1	2	3	4	5	6	7	8	9	10	11	12
	Line and Surface Costs per Mile Main Track		Gross Tonnage Handled			Adjustment to Eliminate Effect of Traffic Changes					
Index Number	Average Abnormal Period (Per Year)	Average Normal Period (Per Year)	Average Abnormal Period (Per Year)	Average Normal Period (Per Year)	Per Cent Increase in Traffic Value, Normal Over Abnormal Periods, 100% Col. 4-Col. 5	Computing Effect of Traffic Changes at 55% Col. 6-55%	Money Adjustment Percentage in Col. 7-Col. 3	Normal Period Expenditures After Eliminating Effect of Changes in Traffic per Mile Main Track per Year Col. 3-Col. 8	Deferred Track Construction Costs per Mile Main Track per Year After Effect of Traffic Changes Are Eliminated Col. 2-Col. 9	Length Abnormal Period, Years	Total Deferred Track Construction Costs per Mile Main Track After Effect of Traffic Changes Are Eliminated Col. 10-Col. 11
1	$ 628	$ 344	3,164,394	3,931,534	19.51	10.73	$ 37	$ 307	$ 321	5	$ 1,605
2	294	197	5,456,908	6,405,188	14.80	8.14	16	181	113	10	1,130
3	288	115	809,783	951,079	14.86	8.17	9	106	182	4	728
4	396	218	5,087,808	6,652,577	23.52	12.94	28	190	206	5	1,030
5	329	208	5,058,708	5,758,969	12.16	6.69	14	194	135	3	405
6	580	277	6,494,671	10,666,660	39.11	21.51	60	217	363	8	2,904
7	383	282	5,037,889	5,983,405	15.80	8.69	25	257	126	7	882
8	362	219	1,761,269	2,023,629	12.96	7.13	16	203	159	3	477
9	....	....	....	Incomplete	....	....	....	....	....	....	....
10	....	....	....	Incomplete	....	....	....	....	....	....	....
11	261	194	4,619,383	6,323,929	26.95	14.82	29	165	96	5	480
12	133	96	129,483	127,966	* 1.19	* .65	* 1	97	36	4	144
13	91	66	189,355	319,260	40.69	22.38	15	51	40	6	240
14	300	203	4,274,747	6,729,084	36.47	20.06	41	162	138	8	1,104
15	378	308	2,178,502	4,253,651	48.79	26.83	83	225	153	7	1,071
16	358	276	1,760,719	2,196,559	19.84	10.91	30	246	112	6	672
17	201	151	1,326,624	2,205,250	39.84	21.91	33	118	83	4	332
18	279	60	3,848,732	4,497,486	14.42	7.93	5	55	224	2	448
19	....	....	....	Incomplete	....	....	....	....	....	....	....
20	300	193	4,274,747	8,522,067	49.84	27.41	53	140	160	8	1,280
21	213	111	1,135,917	2,848,219	60.12	33.07	37	74	139	3	417
22	134	97	179,141	189,163	5.30	2.92	3	94	40	6	240
23	151	94	667,549	1,008,024	33.78	18.58	17	77	74	5	370
24	392	176	2,653,646	4,719,670	43.77	24.07	42	134	258	6	1,548
25	....	....	....	Incomplete	....	....	....	....	....	....	....
26	330	158	4,057,464	5,010,721	19.02	10.46	17	141	189	5	945
27	668	304	6,880,909	8,345,170	17.55	9.65	29	275	393	5	1,965
28	236	110	3,786,100	5,152,180	26.51	14.58	16	94	162	4	648
29	....	....	....	Incomplete	....	....	....	....	....	....	....
Totals and Averages	$7,705	$4,457	74,834,448	104,821,435	28.61	15.74	$702	$3,755	$3,950	129	$21,231

Average for the 24 studies in this tabulation 5.375
Total Deferred Track Construction Costs of the 24 studies in this exhibit before eliminating effect of traffic changes, $17,171
Per cent increase due to elimination of traffic changes as a factor 23.645%
*Credit.

Appendix E—Methods of Special Treatment for Culverts Where There Is Liability of Blocking by Storm Water Deposits, and Special Treatment to Prevent Washing and Deposits on the Right-of-Way by Water in Side Ditches

The greatest trouble from culverts becoming blocked in times of storms is experienced at the smaller streams in localities where a railroad, following a large stream at low grade, crosses the tributaries of the large stream as they issue from the hills and strike the flatter ground. The problem is to reduce the carrying capacity of the water, prevent erosion of the banks and bottom of the stream, or otherwise prevent flood deposits from reaching the culverts.

A drift catcher constructed of old rails either driven into the ground or set in concrete with their tops properly anchored, is very effective in stopping drift material. After the storm, the drift material can be collected and burned.

A cheap and effective method employed by the Chicago, Burlington & Quincy to reduce the velocity of the water is the construction of tree dams. These were built by setting a large post in the center of the stream and anchoring it top and bottom up-stream. Trees were then laid with the butts against the up-stream edge of the post, the tops being allowed to press against the bank on either side, forming a V-shaped dam. The dams were built three, four and five feet high and so spaced that the base of one dam would be practically on a level with the top of the dam next below it. After the first heavy rain, each one of these dams became filled with debris and the channel below the lower dam washed itself clean in such a way that no trouble has been experienced since, while before the installation it was frequently necessary to use a dragline or steam shovel to clear the creek after a heavy rain.

There are locations where material is deposited at the lower end of the culvert and gradually backs up until the entire opening is filled. This condition can usually be overcome by the construction of a concrete conduit or flume for a sufficient distance from the lower end of the culvert, thereby increasing the velocity of the water and carrying the material beyond the culvert.

A new method of protecting banks against erosion, recently advocated and known as the "Angular Submerged Tree Planting System," is being tried on the Erie in the vicinity of Hornell, N. Y., and is described in a report from that road, which is abstracted below:

"Work of planting was started in March, 1923, as soon as the frost was out of the ground. The method of planting was simple. For the stream bottom, shallow trenches were plowed or dug across the valley at intervals of 10 or 12 ft., and willow poles laid in these and covered. In the banks a hole was made at the foot at intervals of 2 to 5 ft. with a bar and a shallow trench (where possible) made in the slope; the pole was then thrust into the hole or trench and covered lightly.

"The most serious problem in connection with this

work was the danger of having the poles washed out by a severe storm before they had taken root sufficiently to hold. As a partial insurance against this stout fences were constructed across the stream at intervals, with the idea of breaking up the velocity.

"A vigorous growth from the poles was evident in June, some shoots reaching a length of 2½ to 3 ft. As the root structure of this plant is about five times as extensive as the shoots, there is every reason to believe that this experiment will be successful.

"While it will take a few years' more growth to demonstrate the success of this method of controlling eroding streams, the results so far are encouraging."

Water in Side Ditches

In preventing washing and deposits on right-of-way by water in side ditches, open concrete ditches of suitable design and grade have proved very effective. Where an open ditch cannot be maintained, tile or pipe should be used to carry the water. Open side ditches should be kept free from weeds and brush and of such design as to reduce all possible friction. Where it is at all practicable, water should be diverted or intercepted and prevented from reaching the right-of-way.

Conclusions

Where there is liability of culverts becoming blocked by storm water deposits, the velocity of the stream should be checked by the construction of a series of dams to reduce the carrying capacity of the water, thereby preventing gravel, debris, etc., from reaching the culvert. At places where this cannot be done, gravel racks or drift catchers should be constructed up stream from the culvert to prevent drift material reaching the culvert.

At points where the trouble lies below the culvert and deposits block the culvert from the lower end, means should be provided by the construction of a proper conduit or flume to increase the velocity of the water so that the drift material will be carried beyond the culvert.

To prevent washing and deposits on right-of-way by water in side ditches, construct concrete ditches of such design and grade as to give the water sufficient velocity to prevent depositing of material in ditch.

Where open ditches cannot be properly maintained, tile or pipe should be used.

Appendix F—Revise Roadway Sections to Meet Requirements of Standard Ballast Sections

After a thorough investigation, the committee does not feel that it should recommend a minimum roadway width of more than 20 ft., but suggests the following change be made in the Manual:

Present Form	Proposed Form
Class A railways, with constant and heavy traffic, should have a minimum permanent width of 20 ft. at subgrade.	Class A railways, with constant and heavy traffic, should have a minimum permanent width of 20 ft. at subgrade. A roadbed shoulder of not less than 18 in. should be maintained outside of the toe of the ballast slope.

Discussion

C. M. McVay (chairman): *The committee moves that the amendment to the Manual, as shown in Appendix A, and also in Appendix F, be accepted and printed as shown.*

Maurice Coburn (Penna.): A first-class railroad today has got to have a roadbed wider than 20 ft. The objection has been that if we should say that the standard roadbed must be 24 ft. or 26 ft. or something like that, a howl would be raised immediately.

Mr. McVay: The committee took this matter up with a great number of the larger roads and found that there were quite a number of those roads—the majority, no doubt—using the two feet of ballast under the tie, but are not making the ballast section as wide as provided by the A.R.E.A. standard ballast plan. In fact, instead of the 12 in. of sub-ballast as shown on the standard plan which tapers off to the edge of the stone ballast, for instance, a lot of them are putting a blanket of 12 in. or so of cinders or slag over the top of the roadway and calling that roadbed and not ballast, and thus only showing 12 in. of ballast.

It also appears from the ideas expressed by a good many of the roads that they would not count on building more than 20-ft. roadbeds on new line, but it seems that this roadbed of 20 ft. is something that gradually builds up. For instance, in re-ballasting the ballast is thrown out on the shoulders and more ballast is put under the track and it is raised higher and the roadbed naturally is widened. Moreover, the committee does not restrict roadbeds to 20 ft. It says a minimum permanent width, and that is a pretty definite figure.

L. J. F. Hughes (C. R. I. & P.): It seems to me that this definition for change in the Manual about the roadbed should include the clause "for single track."

President Lee: The committee accepts that suggestion.

(Motion carried.)

J. C. Wrenshall (P. & R.) read the report of the sub-committee on economics of filling bridge openings.)

Mr. Wrenshall: Our method of arriving at the figures represents such information as we could gather from the figures obtainable on several roads, but it should be understood that our computations are not intended to go into great refinements. We feel that our reasoning is sound and that the general outline of the steps to be taken to arrive at a basis for comparison is logical. We are not endeavoring to set up model figures, but we offer a general scheme of orderly procedure. Also we feel that we are suggesting as simple a plan as possible. We recommend that this report, as well as the first portion thereof, presented to the convention of 1922, be accepted and printed in the Manual. *I move the adoption of that recommendation.*

C. C. Cook (B. & O.): I would like to refer to the item in Column 4, beginning with the words, "As an example, take the case of Bridge 79 in the table. At the end of the second cycle there are contained two renewals of $722 each, interest charges for 14 years, or $43.32 annually, being six per cent on $722." I couldn't quite understand the wording, but I did figure that fourteen times $43.32 was $606.48, and it says there, continuing after that, "adjusted original investment $606.48." In two cycles you would also have interest charges of six per cent for seven years on $722 added to that.

W. H. Woodbury (D. & I. R.): It was thought that that would be absorbed in the operating charges; it is not repeated, and we consider the cost as continued revolving cost.

Mr. Cook: The investment of $722 was made in the beginning of the two cycles. The interest on that money is the proper charge throughout the entire period of 14 years. Then at the end of the first cycle or at the end of 7 years, you could make another investment of $722. The interest on that money, it seems to me, is also a proper charge in figuring total expense through the two cycles.

E. A. Frink (S. A. L.): The committee should take into consideration more than the annual interest charge. The cost of a structure at the end of its life is not composed of the original investment on it plus the interest.

It is made up of the original investment plus the annual interest, plus a depreciation sufficient to extinguish the cost of renewal at the end of its life. If it is considered in that way, then successive renewal is not added because each renewal is extinguished at the end of its life.

Mr. Cook: It seems to me that the committee is all right in limiting the two cycles and alternating the first cost, because it proposes to show whether or not it is economic to substitute another structure, and it is showing that whole cost in Column 11, cost of proposed new structure, to which it adds the annual interest cost of that structure. Then it compares it with the average maintenance cost of the old structure. I do not believe that you should accept Mr. Frink's suggestion that the original cost should be included in such a comparison, but I do still feel that you should have the entire interest charge of all money that you spent for renewal during the entire 14-yr. cycle.

Mr. Woodbury: I do not see how you would be entitled to charge interest on something that has already been charged to operation, and retired. You have only the amount invested in the structure that you are retiring. That is simply carried from period to period as it is renewed. You can't build up interest.

Mr. Frink: The only way you can get at what it finally costs you is either to take the entire cost of the structure and add to it the interest charges, or to transform that into an annual expense by considering the depreciation charges. If you will refer to the section of the Manual on Wooden Bridges and Trestles you will find that subject was thoroughly worked out when the report was issued, and adopted by this convention on the justifiable expenditure for more permanent structure to replace wooden trestles.

Mr. Wrenshall: Inasmuch as there appears to be some doubt as to the clarity of the figures, thoughts and ideas presented, your committee would like to withdraw its motion and recommend instead that the matter be referred back to the committee for further investigation and report next year.

(The other sub-committee reports were next presented by the sub-committee chairman and accepted as information, after which the committee was dismissed with the thanks of the Association.)

Report of Committee on Track

The Committee on Track presented detailed plans of slip switches and frogs and plans and specifications for track tools for publication in the Manual. It also recommended the adoption of a revised and supplemented list of definitions of switch, frog, guard rail, crossing and turnout terms to be substituted for those in the Manual. In regard to the curving of rails, also reported on last year, the committee found that the practice was gradually being discontinued and except on curves much sharper than usually found on main lines, there was no need for it. The re-sawing of rail for re-layers was found to be economical and good practice either with a portable rail saw or at a permanent mill. W. P. Wiltsee has been chairman of the committee for six years and a member for eight years.

W. P. Wiltsee
Chairman

The committee presented reports on the following subjects: Revision of Manual; detail plans of slip switches and frogs, conferring with Committee on Signals and Interlockings; plans and specifications for track tools, collaborating with Committee on Ballast; the effect of brine drippings on track appliances, with tests of tie plates subject to brine drippings; canting of rail inward and taper of tread of wheel, conferring with Committee on Rail and with Committee E, Division V—Mechanical, A.R.A.; method of determining recommendations for rail renewals; curving of rails, recommending limits of curvature within which various weights of rail may be laid without having been previously curved; resawing and conditioning of rails for relaying; tie plate plans; and track construction in and across paved streets and highways; in Appendices A to J, inclusive. The committee recommended: 1. That the changes in the Manual in Appendix A be approved for publication in the Manual. 2. That the plans and specifications in Appendices B and C be adopted as recommended practice and published in the Manual. 3. That the conclusions in Appendices D, E, F, G, H, I and J be approved for publication in the Manual or accepted as information as recommended in the individual reports.

Committee: W. P. Wiltsee (N. & W.), chairman; J. V. Neubert (N. Y. C.), vice-chairman; L. B. Allen (C. & O.), V. Angerer (Wm. Wharton, Jr., & Co.), J. B. Baker (Penna.), C. W. Breed (C. B. & Q.), G. H. Bremner (C. B. & Q.), H. G. Clark (C. R. I. & P.), L. W. Deslauriers (C. P. R.), C. R. Harding (S. P.), W. J. Harris (C. B. & Q.), T. T. Irving (C. N. R.), E. R. Lewis (M. C.), H. A. Lloyd (Erie), R. L. Longshore (Wab.), J. DeN. Macomb (A. T. & S. F.), F. H. McGuigan, Jr. (U. S. R. A.), W. S. McFetridge (B. & L. E.), J. B. Myers (B. & O.), F. L. Nicholson (N. S.), W. G. Nusz (I. C.), J. S. Pole (C. & N. W.), I. H. Schram (Erie), G. J. Slibeck (Pettibone-Mulliken Co.), J. B. Strong (Ramapo-Ajax Corp.), E. D. Swift (B. R. of C.), J. R. Watt (L. & N.)

Appendix A—Revision of Manual

The committee recommended the adoption of a revised and supplemented list of definitions of switch, frog, guard rail, crossing and turnout terms be substituted for definitions in the 1921 Manual, pages 155 and 156, and the first half of page 157. (Note: A number of these items are

identical with those already in the Manual. The revised and added definitions are as follows:)

General Terms

Curve, Simple—A curved track forming an arc of a circle of a single radius.

Curve, Vertical—A vertical bend in the track to connect intersecting grade lines.

Crossing (Track)—A device used where two tracks intersect at grade to permit the traffic on either track to run across the other and comprising four connected frogs, one for each rail intersection. See Frog. (For Details, see Supplement D, "Crossing Terms.")

Elevation (of Curves)—The vertical distance that the outer rail is raised above the inner rail, sometimes called Superelevation.

Flangeway—The space between the running rail and a guard rail which provides clearance for the passage of wheel flanges.

Flangeway Depth—The vertical distance from the top of the running surface of the running rail to the top of a filler or separator introduced between the running rail and guard rail. A minimum depth has been standardized at 1⅞ inch.

Flangeway Width—The distance between the gage line of the running track rail and the guard line of the adjacent guard rail. The standard flangeway width on straight track is 1¾ inch.

Flare—A tapered widening of the flangeway formed by beveling or bending the end of a guard rail or frog wing away from the gage line.

Flare Opening—The horizontal distance between the gage line of the running rail and the side of the head of the guard rail or frog wing rail at the point of maximum opening.

Foot Guard—A filler, preferably of metal, designed to fill spaces between converging rails to prevent the feet of persons becoming accidentally wedged between the rails.

Frog—A device used where two running rails intersect and providing flangeways to permit wheels and wheel flanges on either rail to cross the other. (For Details see Supplement B, "Frog Terms.")

Gage Line—A line ⅝ inch below the running surface of a rail on the side of the head nearest the center of track.

Guard Line—A line on a guard rail which is on the side of the head adjacent to the running rail and on the same level as the gage line.

Guard Rail—A rail laid parallel to the running rails of a track to prevent wheels from being derailed, or to hold the wheels in proper alinement to the track to prevent their flanges from striking the points of switches, or the points of frogs in turnouts or crossings. A rail laid parallel to the running rails of a track to keep derailed wheels on the ties.

Insulation—A device or material that prevents the flow of electric current in a track circuit from passing from one rail to the other or through switches and other track structures.

Joint (Rail)—A fastening designed to unite the abutting ends of contiguous rails.

Joint, Insulated—A rail joint designed to arrest the flow of the electric current from rail to rail by means of insulations so placed as to separate the rail ends and other metal parts connecting them.

Slip Switch, Single—A combination of a crossing with one right hand and one left hand switch and curve between them within the limits of the crossing and connecting the two intersecting tracks without the use of separate turnout frogs.

Slip Switch, Double—A combination of a crossing with two right hand and two left hand switches and curves between them within the limits of the crossing and connecting the two intersecting tracks on both sides of the crossing and without the use of separate turnout frogs.

Splice Bar—A metal angle bar or other shape used in a rail joint and fitting into the sides between head and base of the abutting rails.

Splice Drilling—The spacing of holes in the ends of rails or other track structures to receive the bolts for the fastening of splice bars.

Split Switch—A device consisting essentially of two tapered movable rails with necessary connections, designed to divert rolling stock from one track to another. (For details see Supplement "A," "Switch Terms.")

Surface, Running (Tread)—The top part of track structures on which the treads of the wheels bear.

Track Bolt—A bolt with a button head and oval neck and a threaded nut designed to fasten together rails and splice bars and other rail joint fastenings.

Split Switch Terms

Split Switch with Graduated Risers—A split switch in which the switch rails are gradually elevated by means of graduated riser plates until they reach the required height above the stock rail. (For names of detail parts see Plan No. 191.)

Split Switch with Uniform Risers—A split switch in which the switch rails have a uniform elevation on riser plates for the entire length of the switch. (For names of detail parts see Plan No. 190.)

Manganese Tipped Switch—A split switch in which the head of the tapered rails is cut away in the point portion and manganese steel pieces fastened to the rail to form the point.

Switch Rail or Point Rail—The tapered rail of a split switch.

Point Rail Rise—The elevation of a switch point rail to allow the overhanging part of hollowed out treads of worn wheels to pass over the stock rail.

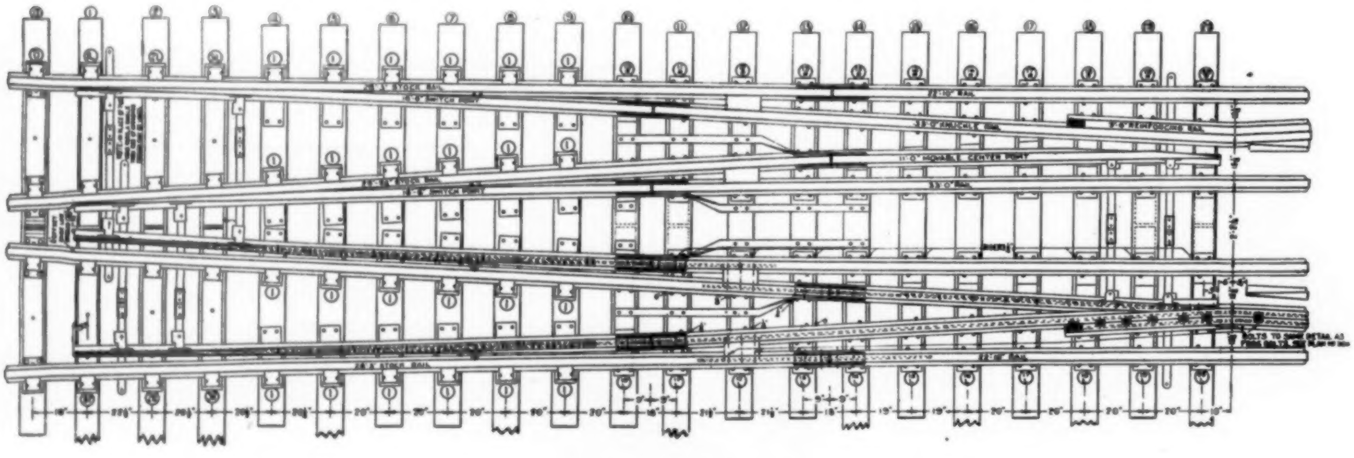
Heel Slope—The inclination produced in that part of the switch by graduated risers, which reduce the elevation (as the height of the risers decrease) toward the heel of the switch.

Bottom Planing—The cut planed at an angle on the bottom of the base of the switch rail from the point and towards the heel to allow the switch rail to rest on the top of the base of the stock rail when the switch rail is closed.

Side Planing—The cuts made on the sides of the head of the switch rail to form the taper from the full width of head to the point.

Top Planing—The cut made on the top of the head of the switch rail from the point and to approximately the head separation.

Chamfer Cut—The vertical beveling of the gage side of the



Details of a No. 10 Double Slip Switch with Movable Center Points and Uniform Risers

switch point to produce a sharp edge to prevent wheel flanges striking the switch point.

Head Separation—The point in a tapered switch rail where the head of the rail assumes its full width.

Point of Switch (Actual)—The point where the spread between the gage lines of the main track and the turnout is sufficient to allow for a practical switch point. (The standard width of switch point is ¼ in.)

Vertex or Theoretical Point of Switch—The point where the gage line of the switch rail, if produced, would intersect the gage line of the stock rail.

Stock Rail—A running rail against which the switch rail operates.

Stock Rail Bend—The bend or set which must be given the stock rail at the vertex of a switch to allow it to follow the gage line of the turnout.

Heel of Switch—That end of a switch rail farthest from the point of switch.

Heel Spread—The distance between gage lines at the heel of the switch rails. This has been standardized at 6¼ in.

Switch Angle—The angle included between the gage lines of the switch rail and the stock rail.

Switch Fixtures—The connecting and bearing parts for the rails of a split switch. (For details and names of parts see Plans No. 201, 202, 203 and 204.)

Insulated Switch—A switch in which the fixtures connecting or reaching from one rail to the opposite rail are provided with insulation so that an electric track circuit cannot pass through them.

Detector Bar.—A strip of metal mounted alongside the track rail and connected with the throwing mechanism of the switch to prevent the moving of the switch under trains.

Throw of Switch—The distance through which the point of switch rails are moved sidewise, measured along the center line of the rod nearest the point connecting the two switch rails, to bring either point against the stock rail. This distance is standardized at 4¾ in.

Frog Terms

Bolted Rigid Frog—A frog built entirely of rolled rails, fillers between the rails and rigidly held together with bolts. (For names of detail parts see Plan No. 390.)

Clamp Frog—A frog built of rolled rails, fillers between the rails, and held together with clamps. (For names of detail parts see Plan No. 391.)

Spring Rail Frog—A frog having a movable wing rail held against the point rail by springs, normally presenting an unbroken running surface to wheels using one track while the flanges of wheels on the other track force the wing rail away from the point rail to provide opening. (For names of detail parts see Plan No. 490.)

Spring Rail Frog, Right Hand and Left Hand—Standing at the toe end of the frog and looking towards the point the right-hand spring frog has the spring wing rail located on the right-hand side, and the left-hand spring rail frog has it located on the left-hand side.

Railbound Manganese Steel Frog—A frog consisting of a manganese steel center casting fitting into and surrounded by rolled rails and rigidly held together with bolts. (For names of detail parts see Plan No. 690.)

Solid Manganese Steel Frog—A complete frog cast entirely of manganese steel. (For names of detail parts see Plan No. 691.)

Self-Guarded Frog (Flange Frog)—A frog provided with a guard member for guiding the flange of a passing wheel past the point of the frog by engaging the tread rim of the wheel in a horizontal plane above the top of running surface of the frog.

Frog Angle—The angle formed by the intersecting gage lines of a frog.

Heel End of Frog—The end of a frog farthest from the switch and where the running surfaces, diverging from the point, terminate.

Toe End of Frog—The end of a frog in front of the point and towards the switch.

Heel Spread—The distance between the gage lines at the heel end of the frog.

Toe Spread—The distance between the gage lines at the toe end of the frog.

Throat of Frog—The point at which the converging wings of a frog are closest together.

Frog Point—The part of a frog lying between the gage lines extending from their intersection to the heel end.

Point of Frog—

Theoretical—The point of intersection of gage lines of the frog.

Half-Inch Point—A point located at a distance from the theoretical point towards the heel and equal in inches to one-half the frog number and at which the spread between the gage lines is ½ in. It is the origin from which shop measurements are made.

Actual Point—A point at which the spread between the gage lines is sufficient to allow for a practical width of manufactured point.

Guard Point—The point formed by guards introduced or extended into the toe portion of a frog.

Heel Length—The distance between the heel end and the half-inch point of a frog, measured along the gage line.

Toe Length—The distance between the toe end and the half-inch point of a frog, measured along the gage lines.

Guard Rail Terms

Guard Rail (Turnout)—A rail or other device laid parallel to the running rail opposite a frog, to form a flangeway with the rail and hold wheels of equipment to the proper alinement when passing through the frog. (For names of detail parts of guard rails see Plan No. 590.)

Guard Rail (Switch)—A rail or other device laid parallel to the running rail ahead of a split switch and forming a flangeway with the rail to hold wheels of equipment in proper alinement when approaching a closed switch point.

Guard Rail Brace—A metal shape to fit the contour of the side of the guard rail and extending over the ties and fastened thereto to prevent moving or tilting of the guard rail away from the running rail.

Guard Rail Brace, Adjustable—A guard rail brace moving on a tie plate, without disturbing the tie plate and securable thereto, to vary the distance between the guard rail and the running rail.

Guard Rail Clamp—A device consisting of a yoke and fastening devices engaging the running rail and guard rail to hold them rigidly in relation to each other.

Adjustable Separator—A metal block of two or more parts acting as a filler between the running rail and the guard rail and so designed as to provide varying widths of flangeway.

Crossing Terms

Bolted Rail Crossing—A crossing in which all running surfaces are of rolled rail and the parts are held together with bolts.

Manganese Steel Insert Crossing—A crossing in which a manganese casting is inserted into the intersections, fitting into the rolled rails and forming the points and wings of the crossing frogs.

Solid Manganese Steel Crossing—A crossing in which the frogs consist entirely of manganese steel castings.

Center Frogs—The two frogs at opposite ends of the short diagonal of a crossing.

End Frogs—The two frogs at opposite ends of the long diagonal of a crossing.

Running Rail—The rail or surface on which the tread of the wheel bears.

Guard Rail—The rail placed parallel with the running rail with the flangeway between them.

Easer Rail (Easer)—A rail placed with its head along the outside and close up to the head of the running rail and sloped at the ends to provide a bearing for the overhanging portion of hollowed-out treads of worn wheels.

Single Rail Crossing—A crossing in which the connection between the end frogs and center frogs consist of running rails only.

Two-Rail Crossing—A crossing in which the connection between end frogs and center frogs comprises running rails and guard rails.

Three-Rail Crossing—A crossing in which the connection between end frogs and center frogs comprises running rails, guard rails and easer rails.

Movable Point Crossing—A crossing in which each of the two center frogs is formed of an obtuse point or knuckle rail and two opposed movable tapered rails, with operating mechanism connecting them so that when two of the movable rails lie against the point or knuckle rails, giving a continuous running surface on one track, the other two stand away from the point to give clearance for the wheel flanges to pass. (Used in small angle crossings and slip switches.)

Knuckle Rail—A bent rail forming the obtuse point against which the movable rails operate in a movable point crossing.

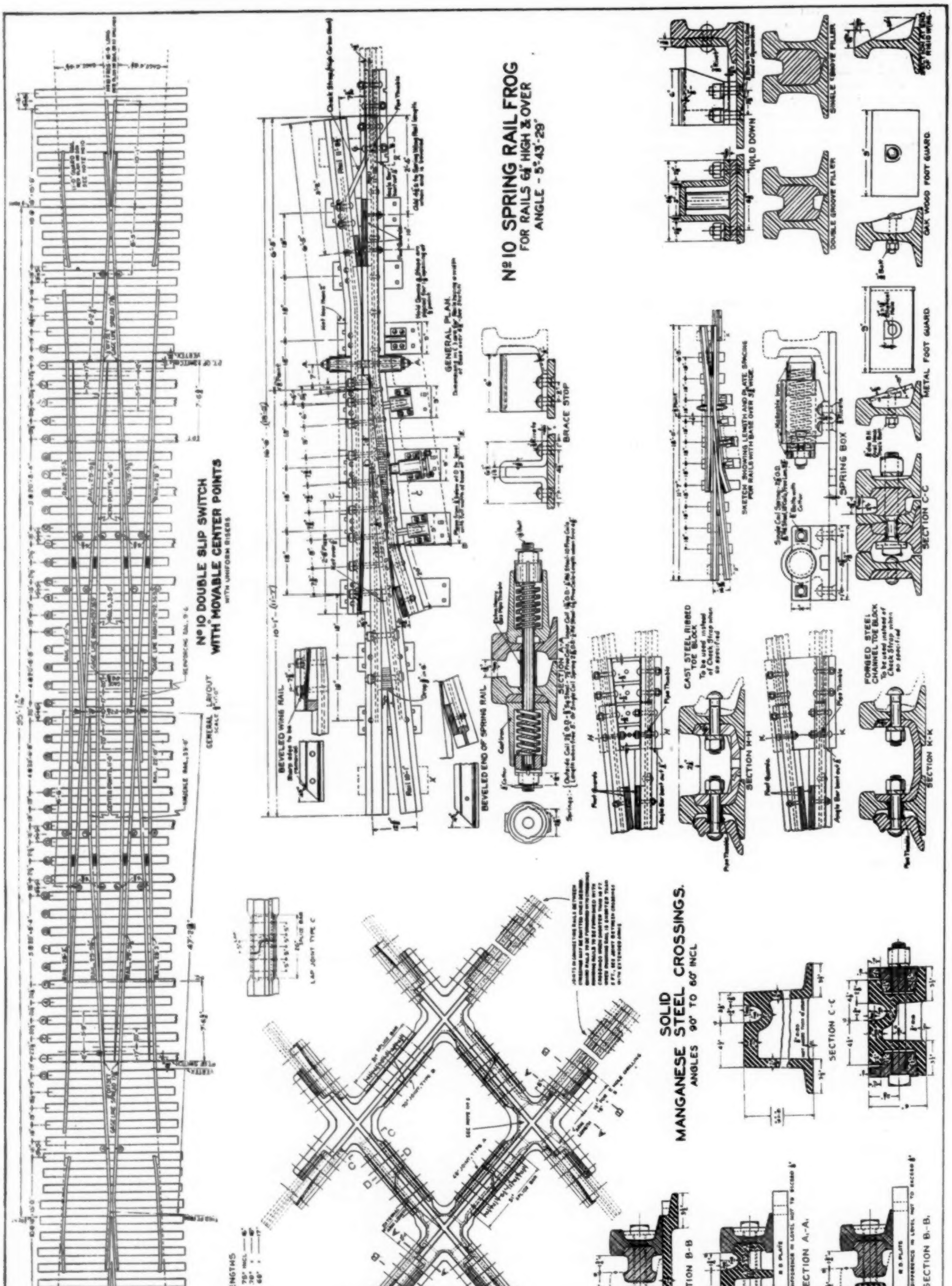
Movable Center Point—The movable tapered rail in a movable point crossing.

Reinforcing Rail—A piece of rail placed along the outside of the head of the knuckle rail or movable center point for strengthening and to act as an easer rail.

Turnout Terms

Lead (Theoretical)—The distance from the theoretical point of a uniform turnout curve to the theoretical point of the frog, measured on the line of the parent track.

Lead (Actual)—The length between the actual point of the


Nº 10 DOUBLE SLIP SWITCH WITH MOVABLE CENTER POINTS
Nº 10 SPRING RAIL FROG
FOR RAILS 6½" HIGH & OVER
ANGLE - 5°43'29"
SOLID MANGANESE STEEL CROSSINGS.
ANGLES 90° TO 60° INCL
GENERAL PLAN
BRACE STOP
SPRING BOX
HOLD DOWN
SECTION C-C
SECTION H-H
SECTION K-K
SECTION A-A
SECTION B-B
BEVELED WING RAIL
BEVELED END OF SPRING RAIL
ARM LENGTHS

switch and the half-inch point of the frog measured on the line of the parent track.

Lead Curve—The curve in the turnout interposed between the heel of the switch and the frog.

Curved Lead—The length measured on the outside gage line of turnout from the point of switch to the point of frog.

Closure Rails (Lead Rails)—The rails connecting the heels of the switch rails with the toe end of the frog.

Turnout Number—The number corresponding to the frog number of the frog used in the turnout.

ITEM 2—CHANGES TO PLANS

The committee recommended the following changes in adopted plans:

Plan 852, adopted March, 1923, details of No. 8 double slip switch with movable center points with graduated risers.

Change length of chamfer cut specified in "Details of Center Point and Knuckle Rail" from 18 in. to 9 in.

(Nine inches, it has been decided, is the correct length to agree with other plans.)

Plan 204, adopted March, 1920, details of split switch fixtures—heel plates and turnout plates for 22-ft. and 30-ft. switches.

Change distance between spike holes on plate, Detail 2034, from 4½ in. to 3½ in.

(This dimension was originally intended and checks with other dimensions given.)

Plan 320, adopted March, 1921, data for laying out bolted rigid frogs.

Change toe spread for No. 9 frog given in table from 8 1-16 in. 8 in.

(Eight inches is the correct dimension.)

Plan 252, adopted March, 1922, detail of lamp tips for switch stands.

Change two dimensions 9-32 in., given on diagram of lamp tip, type 61, to 7-32 in.

(This was the dimension originally intended and checks with other dimensions given.)

ITEM 3—CHANGES IN SPECIFICATIONS

The committee recommended the following change in specifications for the design and dimensions of manganese steel pointed switches:

Page 233, fifth paragraph, first line:

Change dimension "12 in." to "½ in.," making this line read:

"The end of the point shall be ½ in. below the top of the . . ."

(Typographical error.)

The committee also recommended the following change in specifications for switches, frogs, crossings and guard rails.

Page 219, Section 38, first sentence:

Insert the words "bolted rigid" preceding the word "frogs" and "bolted rail" preceding the word "crossings," making the sentence read:

"Main or body bolts in bolted rigid frogs and bolted rail crossings shall have a tight fit in straight, true holes."

(This change is recommended so the specifications will correspond with specifications on plans of manganese work.)

Appendix B—Detail Plans of Switches and Frogs, Crossings and Double Slip Switches

The committee recommended that the following plans be adopted as recommended practice and printed in the Manual:

Double Slip Switches

No. 803—No. 10 double slip switch with movable center points with uniform risers.

No. 804—No. 10 double slip switch with movable center points with graduated risers.

No. 853—Details of No. 10 double slip switch with movable center points with uniform risers.

No. 854—Details of No. 10 double slip switch with movable center points with graduated risers.

Solid Manganese Crossings

No. 771—Solid manganese steel crossings, angles 90 to 60 deg., inclusive.

No. 772—Solid manganese steel crossings, angles 60 to 40 deg., inclusive.

No. 776—Solid manganese steel crossings, steam railroad over electric railway, angles 90 to 60 deg., inclusive.

No. 777—Solid manganese steel crossings, steam railroad over electric railway, angles 60 to 40 deg., inclusive.

Designs for Heavy Rail of 6½ in. Height and Over

No. 404—No. 10 spring rail frog for rails 6½ in. high and over, angle 5 deg. 43 min. 29 sec.

No. 205—Details of split switch fixtures for rails 6½ in. high and over—general.

No. 206—Details of split switch fixtures for rails 6½ in. high and over—special features.

No. 207—Details of split switch fixtures for rails 6½ in. high and over—heel plates and turnout plates for 11-ft. and 16-ft. 6-in. switches.

No. 208—Details of split switch fixtures for rails 6½ in. high and over—heel plates and turnout plates for 22-ft. and 30-ft. switches.

No. 212—Illustration bills of material for rails 6½ in. high and over, for 11-ft., 16-ft. 6-in., 22-ft. and 30-ft. split switches.

Appendix C—Specifications for Track Tools

Pinch Bar, Lining Bar, Rail Fork, Spike Pullers and Rail Tongs

Material and Manufacture.—Each tool shall be forged from high grade steel made by the open-hearth process and shall be drawn down under a power hammer from a single oversized bar to the dimensions shown on the plans.

Chemical Composition.—The chemical composition for these tools shall be within the following limits:

Carbon	0.55 to 0.75	per cent
Manganese	0.40 to 0.55	per cent
Sulphur	Not to exceed 0.04	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	Not to exceed 0.20	per cent

Workmanship and Finish.—The tools shall be forged down to conform to the shape and dimensions as shown on the plans. A permissible variation of 1-16 inch over or under the indicated cross dimensions and ½ in. in length will be allowed, except the spike puller, for which the permissible variation in length shall be ⅛ in. The shape of the jaws in the spike puller and rail tongs as indicated on the plans shall be maintained.

Detail Specification for Claw Bar

Material and Manufacture.—Each tool shall be forged from high-grade steel made by the open-hearth process and shall be drawn down under a power hammer from a single oversized bar to the dimensions shown on the plan.

Chemical Composition.—The chemical composition for the claw bar shall be within the following limits:

Claw Bar Forged from Open-Hearth Steel

Carbon	0.55 to 0.75	per cent
Manganese	0.40 to 0.55	per cent
Sulphur	Not to exceed 0.04	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	Not to exceed 0.20	per cent

Physical Properties and Tests.—The bar shall show a Brinell hardness of 275 to 350, the Brinell reading to be taken on the claw.

Workmanship and Finish.—The claw bar shall be forged down to conform to the shape and dimensions as shown on the plans. A permissible variation of 1-16 in. over or under the indicated cross-dimensions and ½ in. in length shall be allowed. The claw opening dimensions shall not vary to exceed 1-32 in. and the shape of the opening as indicated on the plan shall be maintained.

Detail Specification for Track Wrenches

Material and Manufacture.—The track wrench shall be forged from high-grade steel manufactured by the open-hearth process and drawn down under a power hammer from a single oversized bar to the dimensions shown on the plans. Bearing points must be accurately milled or mandreled to insure accurate dimensions.

Chemical Composition.—Chemical composition for track wrench shall be within the following limits:

Carbon	0.60 to 0.70	per cent
Manganese	0.40 to 0.55	per cent
Sulphur	Not to exceed 0.04	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	Not to exceed 0.20	per cent

Physical Properties and Tests.—Track wrenches shall have a Brinell hardness of 225 to 300, readings to be taken ⅛ in. from the wearing edge.

Workmanship and Finish.—The track wrench shall be forged down to conform to the shape and dimensions as

shown on the plans. A permissible variation of 1-16 in. over or under the indicated cross-dimensions and ½ in. in length will be allowed. A permissible variation of 1-32 in. over or under in the jaw opening as indicated on the plans shall be maintained.

Detail Specification for Adze

Material and Manufacture.—Each tool shall be forged from high-grade steel made by the open-hearth, crucible or electric furnace process and shall be carefully oil-tempered and the blade ground in accordance with the plan.

Chemical Composition.—The chemical composition for these tools shall be within the following limits:

Carbon	0.55 to 0.65	per cent
Manganese	0.40 to 0.50	per cent
Sulphur	Not to exceed 0.04	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	Not to exceed 0.20	per cent

Physical Properties and Tests.—Adzes shall have a Brinell hardness of 375 to 450, readings to be taken ½ in. from the cutting edge.

Workmanship and Finish.—Each tool shall be forged down to conform to the shape and dimensions as shown on the plans. A permissible variation of ⅛ in. over or under in width of blade, 1-32 in. over or under in thickness of blade, ¼ in. over or under in length of adze and 1-16 in. over or under in other cross-dimensions will be allowed, but the shape of the cutting edge of the adze as indicated on the plans shall be maintained.

Detail Specification for Sledge, Spike Mauls and Clay Picks

Material and Manufacture.—Each tool shall be forged from high-grade steel made by open-hearth, crucible or electric furnace process and shall be drawn down under a power hammer from a single over-sized bar to dimensions shown on the plans.

Chemical Composition.—The chemical composition of these tools shall be within the following limits:

Carbon	0.60 to 0.75	per cent
Manganese	0.40 to 0.50	per cent
Sulphur	Not to exceed 0.04	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	Not to exceed 0.20	per cent

Physical Properties and Tests.—Sledges and spike mauls shall have a Brinell hardness of 425 to 500, readings to be taken on the striking surface of the tools.

Workmanship and Finish.—The tools shall be forged down to conform to the shape and dimensions as shown on the plans. A permissible variation of ⅛ in. over or under the indicated cross-dimensions and ¼ in. variation in length will be allowed. A variation of 1-32 in. over or under from the ¼-in. taper in the eye of the spike maul will be allowed.

Detail Specification for Track Chisel

Material and Manufacture.—Track chisel shall be forged from crucible or electric furnace steel and shall be drawn down under a power hammer from a single oversized bar to dimensions shown on the plan. Each tool shall be carefully oil-tempered and ground.

Chemical Composition.—The chemical composition for this tool shall be within the following limits:

Carbon	0.80 to 0.90	per cent
Manganese	0.35 to 0.40	per cent
Sulphur	Not to exceed 0.25	per cent
Phosphorus	Not to exceed 0.04	per cent
Silicon	0.10 to 0.20	per cent

Physical Properties and Tests.—Chisels shall have a Brinell hardness of 350 to 450, readings to be taken ¾ in. back from cutting edge. Each chisel shall be held against the surface of a new open-hearth rail and receive three blows from a 15-lb. sledge without injury to the chisel; the chisel to be held at an angle of 45 deg. to the surface of the rail, the rail to be of open-hearth process, A.R.E.A. specifications.

Workmanship and Finish.—Track chisel shall be forged down to conform to the shape and dimensions as shown on the plans. A permissible variation of 1-16 in. over or under from the indicated cross-dimensions and ⅛ in. variation in length will be allowed, but the shape of the cutting edge as indicated on the plans shall be maintained.

Detail Specification for Track Gage

Material and Manufacture.—Track gage shall be made from 1-in. gas pipe with cast steel or malleable iron end pieces riveted to the gas pipe as shown on the plan. The gage shall be insulated with fiber bushing when required.

Workmanship and Finish.—End castings shall be smooth and free from cracks, blisters or other imperfections and shall be milled to an even bearing as shown on the plan. They shall be securely fastened to gas pipe by rivets, which shall have countersunk heads on the underside of the gage. A permissible variation in gage measurement of 1-32 in. will be allowed.

Detail Specification for Track Level

Material and Manufacture.—Track level shall be made from clear, white pine, which shall be thoroughly seasoned and free from checks, knots, worm holes and other injurious defects. The metal bands shall be fastened to the wood with the countersunk flat head screws. The track level shall be equipped with level glass sufficiently accurate to indicate a 1-16-in. difference in elevation in a horizontal distance equal to the gage of the track. Level glass shall be set flush with the upper surface of the track level and shall be securely screwed to the wood with brass screws having countersunk heads. The level glass shall be protected with 7/16-in. round iron handle, as shown on the plan. The adjustable track level shall have an elevation stem of brass or malleable iron accurately graduated to ¼ in. and with each inch numeral legibly stamped thereon. The thumb space plate shall be securely bolted through the track level and shall be threaded to fit the thumb screw, which shall be so arranged that it will bear against the elevation stem when screwed in. The threads shall be accurately cut and the fit shall be such that the thumb screw may be screwed in by hand.

Workmanship and Finish.—The track levels shall be finished in a workmanlike manner and shall be free from all flaws or imperfections. Each tool shall be given a priming coat and shall be finished in the natural color with one coat of varnish before leaving the factory.

General Specifications

Workmanship and Finish.—Each tool shall be finished in a workmanlike manner and shall be free from flaws, seams, cracks, irregularities of shape or other imperfections. Each tool shall be coated before leaving the factory with paint, oil or varnish to prevent corrosion and cutting edges of tools shall be oiled.

Marking.—Each tool shall be plainly stamped with the manufacturer's name or brand and the purchaser's initials.

Inspection.—When required by the purchaser, the manufacturer shall furnish samples of material stock for testing before proceeding with the filling of the order and shall give sufficient notice in advance of the date when tools will be ready for inspection.

The inspector representing the purchaser shall have free access at all times while the work on the contract of the purchaser is being performed to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the plant prior to shipment and the manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy himself that the tools are being furnished in accordance with these plans and specifications. The tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works. The inspector shall select one finished tool from each ten dozen or less of purchase and the acceptance or rejection of each lot shall be determined by the result of the tests. Individual tools which develop defects due to poor material or faulty workmanship or which are found not to fulfill the requirements of these specifications shall be rejected and returned at the seller's expense.

In the detail specifications, the permissible variation must not be construed to change the shape and general contour of the tool as indicated on the plans.

Where Brinell hardness tests are specified, other methods may be used, provided equal results are obtained.

Shipment or Delivery.—Tools shall be properly packed for shipment to avoid damage. All bundles and boxes shall be plainly marked with the name of the purchaser, the name of the manufacturer and the point of shipment.

Appendix E—Taper of Tread of Wheel and Canting of the Rail Inward

The following tentative conclusions were presented by the committee:

1. Taper of the wheel tread is not largely the cause of the lateral force on the rail.
2. That the expense of regaging track is largely due to the lateral force on the rail.

3. That there are three ways in which the expense of regaging track may be substantially reduced:

(a) By a proper design of tie plate providing more bearing area outside of the rail than is provided inside of the rail.

(b) By canting the rail, using a tie plate with an inclined upper surface.

(c) The combination of both (a) and (b.)

Appendix G—Curving of Rails

The information received from 20 railroads indicated a wide difference of opinion as to the limits of curvature for which rail should be precurved, and the class of track on which it should be used.

Four of the 20 railroads have discontinued the practice. Four precurve for only curves of such large degree that they are usually found only on light traffic branch lines or sidings. Three report precurving, but have very few curves that come within the required limits. One road reported in error in 1922 that they precurved rail. The other eight roads reporting as following the practice of precurving, can give no data as to economies effected in labor or materials, but all are of the opinion that precurved rails maintain better line and gage than rails lined to the curve when laying.

Analysis of the data at hand lead the committee to believe that the practice of precurving rail is gradually being discontinued, and made the following recommendation to be printed in the Manual: Except on very sharp curves, much sharper than usually found in main line curves, rail need not be curved before laying.

Appendix H—Resawing and Conditioning of Rails for Relaying

There are various methods for re-conditioning rail for its further service in main line track, but all of these methods can be included in the following: re-sawing rail; re-rolling rail; building up the joints and other portions of the rail with electric or oxy-acetylene processes.

Re-rolling rails is the practice of but few railroads at the present time, owing to its cost, and until the re-rolling cost is considerably reduced there will be but few roads who will find this practice economical. The re-sawing of rail is generally practiced by a large number of railroads and the practice is on the increase. The re-conditioning of rail by building up the joints is a new practice, but is one that is attracting a great deal of attention and is gaining in favor rapidly.

Conclusions

That there is no economy in re-rolling rail at the present high cost of doing this work, together with transportation costs necessary to move the rail to the mill and its return to points where it will be placed in the track. There may be exceptional circumstances on some roads, to which this condition would not apply, but generally the railroads of the United States have not found re-rolling economically satisfactory.

That the re-sawing of rail for re-layers is economical and is good practice, either—

(1) With a permanent rail mill owned by the company;

(2) With a portable rail saw owned by the company;

(3) With a permanent or portable rail saw owned by the contractor.

In its study of re-rolling or re-sawing rail for relaying the committee has arrived at the conclusion that the relative economies as between re-sawing and re-conditioning rail by building up the joints in the track by acetylene, electric or other processes, is so interwoven that a study of the economies as between the two methods can best be made by the assignment of both subjects to the Committee on Track.

Discussion

(W. P. Wiltsee, chairman, outlined the reports of the committee on definitions, and suggested changes in the Manual covering plans and specifications as contained in Items 1, 2 and 3 of Appendix A, and the report on designs for switches and frogs as contained in Appendix B, all of which were *adopted for inclusion in the Manual.)*

Chairman Wiltsee: The specifications for track tools have been before the track committee for the past three or four years. The specifications were in pretty good shape last year but it has been thought that we wanted more in the nature of performance requirements in track tools and specifications. A study was made to see what we could do along those lines but we couldn't get anywhere with it. So we feel that these specifications will give us good tools. They have been criticized by several of the leading tool manufacturers in the country. They have been submitted to a number of railroads for tests, and there has been very little criticism offered. The committee recommends the specification for adoption and printing in the Manual, *and I so move.*

Maurice Coburn (Penna.): Do we gain anything by showing the chemical composition in these specifications? Would it not be possible to tell the manufacturer that we want a tool that will do a certain thing, that will stand a certain test rather than tell him how to make it? Maybe he could make some improvements and get what we want without being limited to certain details or method of manufacture.

C. A. Morse (C. R. I. & P.): We went through this suggested form of specification years ago on joints. We got joints of the manufacturer's make, had a few tests made and found that some were made of pretty nearly putty and so we decided to get up a specification of the carbon content and the chemical content. That has done us a lot of good. The committee is warranted in their specification to cover the chemical content.

(The motion to adopt the specifications covering pinch bars, etc., was carried, following which a motion was made to adopt the remaining specification under Appendix B.)

C. W. Baldridge (A. T. & S. F.): The committee has provided that the level glass shall be set flush with the upper surface of the track level and should be securely screwed to the wood with brass screws having countersunk heads. Ordinarily the glass itself is not set in screws. The glass in a track level is ordinarily set into a frame with plaster of Paris or something of that nature. The frame work which carries the glass is then fastened to the upper surface of the track level with screws. The upper surface of this brass plate should be flush with the top of the level but the glass should be low enough to be protected from breakage.

Mr. Wiltsee: That was the intention of the committee. *(Motion carried.)*

(The reports on tie plate tests, on taper of tread of wheels, and on rail renewals were presented in order and received as information without discussion. The report on pre-curving of rail was next presented.)

Mr. Wiltsee: *I move that the last paragraph (Appendix G), be adopted as recommended practice and printed in the Manual. (Motion carried.)*

(The report on the conditioning of rail and the remaining report on track construction in and across paved streets and highways were received as information and as a report of progress respectively. The committee was then excused with the thanks of the Association.)

Report on Economics of Railway Operation

The remarkable record which the railways established last year in moving a tremendous volume of freight without a car shortage has demonstrated the value of constant study of the problems of railway operation. The work of the Committee on Economics of Railway Operation is thus both timely and valuable. Reports were presented this year on methods of increasing the traffic capacity of a railway, on the feasibility and economy of through routing of solid trains and its effect upon the capacity of terminals, and on methods of determining the costs of operation. The through routing of solid trains, as practiced on the Baltimore & Ohio with marked savings in cost, was described. G. D. Brooke has been chairman of this committee for two years and a member since 1917.

G. D. Brooke
Chairman

The committee presented no revisions for the Manual. Progress reports were submitted on the effect of speed of trains upon the cost of transportation; on methods for the determination of proper allowances for maintenance of way expenses due to increased use and increased investment; and on the utilization of locomotives. The committee also presented detailed reports on methods of increasing the traffic capacity of a railway in Appendix C; on methods of analyzing costs for the solution of special problems in Appendix D; and on the feasibility and economy of through routing of solid trains and its effect upon the capacity of terminals in Appendix E. It was recommended by the committee that the part of Appendix D entitled "A formula or Method of Calculating the Cost of Moving Freight Traffic"; and the conclusions of Appendix E relating to the through routing of trains be approved for publication in the Manual.

Committee: G. D. Brooke (B. & O.), chairman; R. T. Scholes (C. B. & Q.), vice-chairman; E. G. Allen (A. T. & S. F.), M. C. Blanchard (A. T. & S. F.), J. M. Brown (C. R. I. & P.), F. W. Brown (A. C. L.), J. W. Burt (C. C. C. & St. L.), B. M. Cheney (C. B. & Q.), E. J. Correll (B. & O.), W. R. Dawson (N. & W.), J. M. Farrin (I. C.), C. S. Gzowski (C. N. R.), E. T. Howson (Railway Age), B. O. Johnson (N. P.), R. B. Jones (C. P. R.), D. J. Kerr (G. N.), E. E. Kimball (Gen. Elec. Co.), M. F. Mannion, F. H. McGuigan, Jr. (U. S. R. A.), A. H. Ostberg (C. B. & Q.), J. F. Pringle (C. N. R.), H. T. Porter (B. & L. E.), Dean W. G. Raymond (Univ. of Iowa), H. A. Roberts (O. W. & N.), L. S. Rose (P. & E.), Mott Sawyer (C. M. & St. P.), D. L. Sommerville (N. Y. C.), J. E. Teal (B. & O.), H. M. Tremaine (Pres. Conf. Com.), F. H. Watts (Penna.), Barton Wheelwright (G. T.), C. L. Whiting (C. M. & St. P.), C. C. Williams (Univ. of Ill.), Louis Yager (N. P.).

Appendix C—Methods of Increasing the Traffic Capacity of a Railway

Fig. 1 shows a suggested form for keeping a running log of freight train performance. Many roads keep the data required for such a log by divisions, in which case it is felt that a superintendent would be greatly benefited if he could have a picture of his operations month by month as fast as the returns are available.

It will be noted that for the first six months of 1922 all the points are above and to the left of the 1921 line, indicating an improvement in road time over that obtained in 1921. If it is imagined that these records are the records of a short division where opportunities have been made to study the effect of various operating conditions, then no doubt the superintendent could assign some reasons for the improvements noted, such as: lighter trains or more favorable weather conditions, etc. This particular diagram has been plotted from statistics published by the Interstate Commerce Commission for the Ohio-Indiana-Alleghany region and, therefore, covers such a wide territory that detail analyses are impossible, but it so happens that important historical events in 1923 are apparent from this study and later an example is given of the kind of studies which can be made from time to time on any particular division to develop better operating methods.

Continuing with the explanation of Fig. 1, it will be noted that beginning with July the points for the next six months are below and to the right of the 1921 line, which can be explained by the fact that the shopmen's strike took effect July 1 and the conditions which resulted had a far-reaching influence upon freight train performance. On account of these unusual conditions 1922 operations cannot be taken as a guide, hence the performance for 1921 is used for a comparison with 1923 operations.

The first three months of 1923 indicate the effect of fuel shortage and cold weather. By April these effects were wearing off, as indicated by the fact that point 4 (April, 1923) shows a tendency to get back on the 1921 line and points 5, 6 and 7 (May, June and July) are on the line. Other points, 8, 9 and 10, are fairly close to the line. It should also be noted that there has been a steady improvement in train weights during 1923. It is not important for this study to dwell upon the facts which brought this about in the case of the Indiana-Ohio-Allegheny region, but anyone responsible for the purchase of heavier motive power would be interested in a comparison of the results obtained by such means on any particular section of track and it would be a source of considerable satisfaction to be able to visualize the effect by some such diagram as shown.

To properly interpret the reasons for variations from the normal it is necessary to make investigations along several different lines, of which the study made last year of the "Effect of Double Tracking on Freight Train Operation" is one example and the study made this year on the "Effect of Passenger Train Operation Upon Freight Train Performance" is another.

The Effect of Passenger Train Operation Upon Freight Train Performance

The method used in this investigation is an abridgment of the method described last year. The method of plotting train-hour diagrams is rather cumbersome for many investigations, hence it is felt a simpler method can be put to use for preliminary studies and later, if closer determinations are required, the train-hour method can be used.

To determine the effect of passenger train operation on freight train performance, two districts were chosen and about 76 days were selected between May 1 and August 31, 1923, when a variable number of freight and passenger trains were operated. On the 98-mile district NV-W there were 40 days when 12 passenger trains per day were operated. On these days the number of freight trains operated per day varied from 9 to 16, as indicated in Fig. 3. No attempt has been made to check the figures with respect to other variable operating conditions, so that naturally there is a great deal of variation from the straight line which is drawn through the midst of these points. This straight line can be taken as representing the average or theoretical variation of the average road time of freight trains when twelve passenger trains per day are operated.

Of the 76 selected days, 11 days were found when only seven passenger trains per day were operated, three days when eight, one day when six passenger trains per day were operated. The number of freight trains operated on these days varied about the same as when 12 passenger trains were operated, hence the same procedure was followed in drawing the straight line through the midst of these points, Fig. 4. The theory calls for these two lines to intersect the horizontal axis at the same point. So far as the actual points are concerned, there is nothing which indicates the two lines intersect the horizontal axis at different points, hence the straight line for seven passenger trains per day has been constructed to pass through the same point on the horizontal axis as the straight line for twelve passenger trains per day.

In addition, there were a number of other days when there were 11, 13, 15 and 16 passenger trains per day operated, but there was not enough of them to determine the slope of corresponding lines. These points are plotted in Fig. 5 to show that the points, for the most part, indicate that when there are 13, 15 or 16 passenger trains operated, an average road time for freight trains greater than shown for 12 passenger trains can be expected. Likewise when 11 passenger trains per day are operated the tendency seems to be very close to the line shown for 12 passenger trains per day. This is a further check on the manner of drawing the lines.

The same procedure has been followed for the short section C-NV—72 miles. In this case the difference in the number of passenger trains per day is only one, yet the effect on freight train performance is appreciable.

Considering Fig. 6, assume that there are seven passenger trains and 14 freight trains operated per day. It will be seen that the average road time per freight train is 7.05 hours for a 98-mile run. If the number of freight trains per day remains at 14 and it is desired to increase the number of passenger trains from 7 to 12, then the average road time per freight train will be increased from 7.05 hours to 7.9 hours an amount represented by "B." In other words, the addition of five passenger trains per day to the service adds in this case an average of .85 hours to every one of the 15 freight trains. Hence, if the running log sheet showed a point 0.85 hours off the line and it was known that the passenger service had been increased during this period by five trains, it could be assumed that this condition was largely the cause for the apparently poorer showing. By a similar study changes in other conditions might show where better operation could be obtained. However, with such knowledge the extra crew time for the freight service could be charged against the cost of providing extra passenger service.

Likewise, suppose it was desired to know how much the freight service could be increased and still not exceed the average road time of crews if five passenger trains per day were taken off, assuming that there were already 12 passenger and 14 freight trains per day.

The average road time corresponding to 14 freight trains and 12 passenger trains is 7.9 hours. If there were only seven passenger trains per day, the number of freight trains corresponding to 7.9 hours is 17. That is, five passenger trains in this case have the same effect as three freight trains, or A—B.

In the case of Fig. 10, the effect of one passenger train is the same as one freight train. It would, therefore, appear that the effect of passenger train operation upon freight train performance depends upon length of division, track facilities and profile, etc.

Appendix D—Methods for Analyzing Costs for the Solution of Special Problems

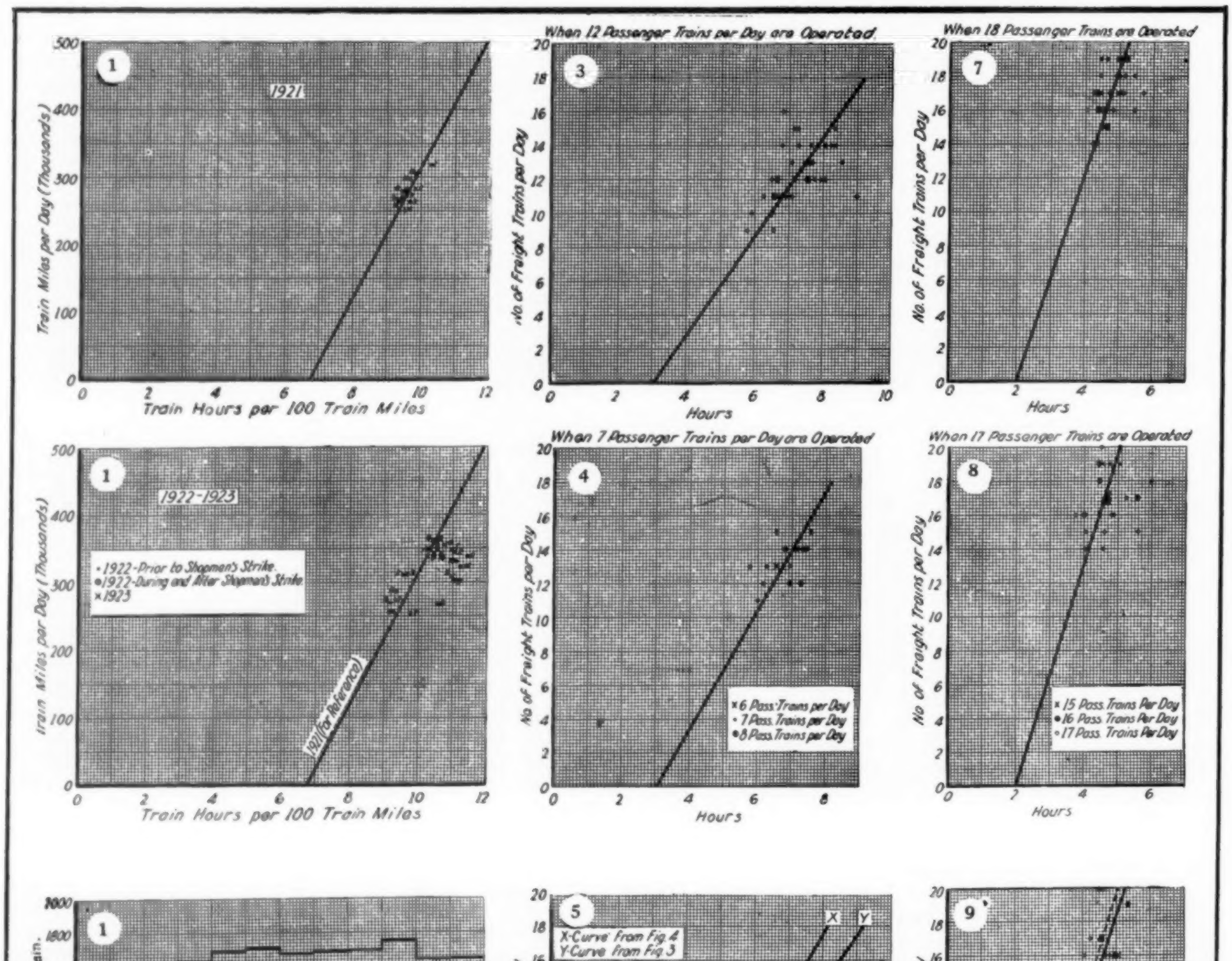
On account of the many variable conditions, such as of alinement, grades, weather and temperature, train load, weight and internal resistance of locomotive, character of equipment in the train, and speed, it is self-evident that no such cost can be determined which will be of general application. The cost will vary and vary greatly as the conditions change and the solution of the problem will lie in determining the proper methods of making allowance for the variable conditions.

The simplest case will be that of a train of given weight and make-up, operating on straight level track at a given speed, under average temperature and weather conditions. The problem is, (1) to determine a method or formula for computing the cost in this simple case, and (2) to devise modifications which will enable the variable conditions—curvature, grades, train load, weight, etc.—to be taken into account and properly reflected.

There are numerous items of cost which should be included in the cost of stopping a freight train and accelerating it to the speed from which it was stopped. The more important items may be classified under the following heading:

Direct Cost	Indirect Cost
1. Fuel.	1. Loss in track capacity; seriousness of which depends on the density of traffic.
2. Water.	2. Loss of the use of equipment, incident to the slower freight movement, and increasing per diem charges.
3. Brakeshoe wear.	3. Damage to cargo due to additional shocks and vibration, as reflected in damage claims from shippers. Amount depends upon character of cargo.
4. Wear and tear of equipment.	4. Adverse advertising.
5. Wear on tracks and roadway.	
6. Wages.	

It would seem possible to determine the items of direct cost by conducting a sufficient number of test or careful observations in the actual operation of freight trains under varying conditions. The committee realize, however, that it is exceedingly difficult to conduct a series of tests from which infromation may be obtained which will make possible the development of a formula that may be applied under all conditions of train load, speed


1
1921
Train Miles per Day (Thousands)
Train Hours per 100 Train Miles
When 12 Passenger Trains per Day are Operated
3
No. of Freight Trains per Day
Hours
When 18 Passenger Trains are Operated
7
1922-1923
• 1922-Prior to Shopmen's Strike
• 1922-During and After Shopmen's Strike
× 1923
1921 (for Reference)
When 7 Passenger Trains per Day are Operated
4
× 6 Pass. Trains per Day
• 7 Pass. Trains per Day
• 8 Pass. Trains per Day
When 17 Passenger Trains are Operated
8
× 15 Pass. Trains Per Day
• 16 Pass. Trains Per Day
• 17 Pass. Trains Per Day
Ave. Tons per Train
Month
5
X-Curve From Fig. 4
Y-Curve From Fig. 3
X
Y
• 11 Pass. Trains per Day
▲ 13 Pass. Trains per Day
× 15 Pass. Trains per Day
• 16 Pass. Trains per Day
9
• 19 Pass. Trains Per Day
▲ 20 Pass. Trains Per Day
× 21 Pass. Trains Per Day
• 22 Pass. Trains Per Day
1923
1921
1922
6
A - Effect of adding 3 Frt. Trains
B - Effect of adding 5 Pass. Trains
Ave. Road Time Frt. Trains (7 Pass. Trains)
Ave. Road Time Frt. Trains (12 Pass. Trains)
10
Ave. Road Time Frt. Trains (17 Pass. Trains)
Ave. Road Time Frt. Trains (18 Pass. Trains)

and track. If it is found impractical to have tests made for the determination of the influence of these variables, the committee will only be able to work out a number of theoretical cases under conditions assumed as close as may be to actual operation.

Of the items of direct cost, fuel and water are factors which will vary with the train load and speed; also with the period of time a train is standing still. Brakeshoe wear will depend upon speed and axle load. Wear and tear of equipment will be very difficult of determination; this item embraces the damage due to shocks and the increased work of the brakes in dispelling the momentum of the moving train and of accelerating the train from a stop to the speed at which it was moving. Wear and tear on track and roadway is an expense item which may be obtained through careful observations extending over a period of years. Wages may or may not be affected. If the delay in stopping the train adds to the overtime (time paid for in addition to the standard day) then it is an important part of the cost to be considered; however, there may often be stops which will not affect the wage item.

The committee has collected data of value concerning the brakeshoe wear and plans are being prepared for obtaining other information regarding the direct items of cost—from observations of actual freight train operation, if practicable—the value of which will depend upon the conditions under which it is obtained.

The indirect costs are indeterminate. They may be large or small, depending on traffic and other conditions existing at the time of the stop, and may have an important influence on the local operation of the railroad. The committee will not endeavor to determine these costs.

A Formula for the Method of Calculating the Cost of Moving Freight Traffic

The method is designated to include maintenance of way, maintenance of equipment, transportation, traffic, general expenses and fixed charges that enter into and should be applied in determining the cost of the movement of freight between any two points on the railroad or through or over any special facility operated by the railroad company incident to performing its function of manufacturing transportation.

The accuracy of the results that may be desired is only limited by the degree of refinement that may be practical in developing the various tables to be used in the application of the formula in solving the many problems of operating costs that are constantly coming before railroad managers. As an illustration, it may be desired to know the cost of handling live stock from a midwestern point to a market center or to tidewater, or the cost of handling grain or other individual commodity or miscellaneous freight between certain points on the line. The formula will also be useful in comparing the cost of moving a given volume of traffic via two different routes. Certain important interests may offer a large additional tonnage for transportation between two points and by the application of this formula it may quickly be determined whether or not this additional business would be profitable.

In presenting the tables the spread, or period of time, the figures cover is not indicated; this must necessarily be left to the individual carrier, as conditions will vary greatly on different railroads. In the case of wages, fuel and other supplies, the latest prices would ordinarily be best. The same thought may apply to most all items in the maintenance of way and maintenance of equipment accounts, except items of repair, where a greater spread should be used in order to take into account seasonal variation in business and expense. Where wages are spread over a long period involving a change in rate of pay, the same should be equated to present-day basis.

Direct and indirect expense items are developed in certain tables: In the maintenance of way and maintenance of equipment accounts the indirect expense is based on the ratio of dollars expended per dollar of direct expense and in the case of transportation accounts the indirect expense is based on the ratio of dollars expended per train mile. In other words, the indirect expense is based on the ratio of expense not affected by use of volume of business handled to expense which is affected by use or the volume of business handled. This method is adapted to problems not involving increases or decreases in traffic; however, should the problem involve a change in the volume of business, it will be necessary to equate the indirect expense units inversely to such variation in the traffic to be handled.

The same consideration should be made in applying the unit costs for fixed charges, which, within certain limits, will increase as the volume of business decreases and decrease as the volume of business increases.

The figures set up in the various tables are of value only in illustrating a plan by which this method or formula may be worked out. Tables of similar units can be set up in forms very concise and convenient for ready reference in applying this method to the problems to be met with on the several operating divisions of a great railroad.

(Note—This report was accompanied by a detailed analysis of all the factors entering into the cost, the methods of deriving the figures in each of a wide series of tables.)

Appendix E—Feasibility and Economy of Through Routing of Solid Trains and its Effect Upon the Capacity of Terminals

The report presented at the last convention was confined to a survey of the extent to which the through routing of solid trains was in effect on the various roads in order to determine those lines which had made the greatest progress in the reduction of switching through the classification of cars at the originating terminal into trains for movement intact through intermediate yards to destination or final break-up points. This study developed the fact that the Baltimore & Ohio has made the greatest progress in this direction, and our work this year has been confined largely to the investigation of the details of this plan. In this investigation the committee has been aided by E. T. Horn, chief of yard and terminal operations of the Baltimore & Ohio, who has met with it and given it much information concerning the practice of that road. An outline of the essential features of the Baltimore & Ohio plan was given in an exhibit attached to the report. (Note: Detailed articles on the Baltimore & Ohio plan have appeared from time to time in past issues of the *Railway Age*.

The committee has also considered the practice of other roads in some detail as follows:

The Chicago, Burlington & Quincy instituted a comprehensive plan for the systematic classification of cars into trains in April, 1921, but the shopmen's strike interfered with it so seriously that the plan did not actually become effective until April 15, 1923. The plan is similar to that of the Baltimore & Ohio, contemplating the grouping of cars into blocks at the initial terminal for movement intact through intermediate yards to destination. While attention was confined at first to the more important time and perishable freight trains, the plan has been extended recently to include the classification of other freight into trains at initial terminal points. The plan also includes a graduated inspection of cars. Among the advantages which have been demonstrated are a reduction in the number of locomotives required

for switching, an increase in the tonnage of manifest trains and in the miles per car per day, and the free movement of freight through terminals which were heretofore congested.

The Grand Trunk has established a plan for the grouping of fast freight moving between Chicago and Montreal and other important points, filling these trains out with dead freight where necessary by adding to or cutting off blocks at the head end. Efforts are being made to extend this plan to cover dead freight, although only limited progress has been made so far.

The Atlantic Coast Line inaugurated the practice about a year ago of running freight trains from Florence, S. C., intact through Rocky Mount to Richmond and Norfolk, and with the completion of yard improvements now under way will extend this to cover the movement of trains from Savannah to Richmond and Norfok, distances of 509 miles and 501 miles, respectively.

The New York Central has operated solid trains between Chicago and New York and Boston for a number of years and has recently established the practice of consolidating coal into solid trains for movement from Cherry Tree, Pa., to Springfield, Mass., and to Syracuse, New York.

The Chicago, Rock Island & Pacific inaugurated a plan last summer for the consolidation of all traffic moving from Chicago and Kansas City to Texas and California points into solid trains which move through as many as seven terminals without break-up.

Conclusions

The committee recommended the following concusions for adoption by the Association and insertion in the Manual:

(1) The collection of cars into groups with the same or similar destination for movement intact through intermediate terminals to destination is practical and will increase the number of cars which can be handled through terminals and reduce the cost chargeable to terminal operation.

(2) Classification should be made according to a systematic plan based on a thorough survey of the origin and destination of all cars, loaded and empty, and of all classification facilities available. The plan should be comprehensive in scope and cover all cars handled.

(3) The plan should provide for the assembling of cars for the same destination into groups as early in their movement as possible.

(4) To insure maximum success and minimum interference with the plan, all delays to cars after being assembled into groups should be reduced to the minimum by the removal of the causes for these delays prior to their grouping. This should include such arrangements for car inspection and repair as will obviate the necessity for setting out cars in bad order short of their destination except as the result of an accident.

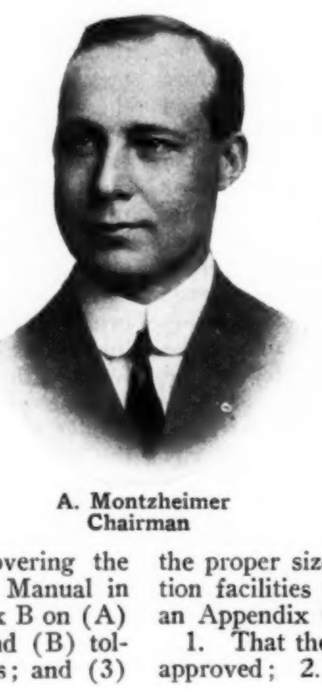
(5) Supervision of the plan should be centered in a system officer with a knowledge of the requirements of the system and with authority to enforce adherence to the plan.

Discussion

(G. D. Brooke, chairman, introduced the report of the committee, which was then presented by the chairmen of the various sub-committees. The subject of methods of increasing the traffic capacity of a railroad was presented by E. E. Kimball, General Electric Company, in the absence of the sub-committee chairman, and accepted as information. This report was followed by the subcommittee's report on methods of analyzing costs for the solution of special problems which was presented by J. E. Teal (B. & O.). *It was moved and carried that this report be published in the Manual as recommended practice.* The next subject was the report on the feasibility and economy of through routing of solid trains and its effect upon the capacity of terminals, presented by E. T. Howson, *Railway Age. It was moved and carried that the conclusions be approved for publication in the Manual.* J. M. Farrin (I. C.), presented a progress report on the work of the sub-committee on utilization of locomotives. The committee was then excused with the thanks of the Association.)

Report on Yards and Terminals

Last year the Committee on Yards and Terminals presented a very detailed and thorough study of the relation which should exist between passenger station facilities and the business handled. This year the committee has carried the study forward to the detailed consideration of certain associated passenger station facilities which are not included in the station building but which are located in the trainshed. In this study, the station platforms and their approaches have been analyzed to determine the proper relationship between their size and arrangement and the volume of business. The results have been shown in a comprehensive conclusion for publication in the Manual. A. Montzheimer, chairman, has been a member of the committee for 20 years and chairman for the last two years.



A. Montzheimer
Chairman

The committee presented reports covering the following subjects: (1) Revision of Manual in Appendix A; (2) scales in an Appendix B on (A) automatic indicating devices for weighing, and (B) tolerances for railroad service weighing devices; and (3) the proper size and arrangement of large passenger station facilities as determined by the business handled in an Appendix C. It recommended:

1. That the changes in the Manual in Appendix A be approved; 2. That the report relating to automatic in-

dicating devices for weighing and tolerances for railroad service weighing devices be received as information; 3. That the three definitions in Appendix C (combined passenger and trucking platform, exclusive passenger platform and exclusive trucking platform) be approved for publication in the Manual; 4. That the conclusions numbered 1 to 34, inclusive in Appendix C be approved for publication in the Manual; and 5. That the remainder of Appendix C be received as information.

Committee: A. Montzheimer (E. J. & E.), chairman; J. G. Wishart (C. R. I. & P.), vice-chairman; F. J. Ackerman (K. C. T.), J. R. W. Ambrose (Toronto Term.), Irving Anderson (A. T. & S. F.), J. E. Armstrong (C. P. R.), W. R. Armstrong (O. S. L.), Hadley Baldwin (C. C. C. & St. L.), F. C. Baluss (D. M. & N.), H. M. Bassett (N. Y. C.), C. A. Briggs, A. E. Clift (I. C.), J. D'Esposito (Chicago Union Station), H. T. Douglas, Jr., (C. & A.), A. W. Epright (Penna.), E. H. Fritch (A. R. E. A.), Otto Gersbach (C. J. R.), John V. Hanna (K. C. Term.), E. M. Hastings (R. F. & P.), R. Hayes (Sou.), J. B. Hunley (C. C. C. & St. L.), D. B. Johnston (Penna.), B. H. Mann (M. P.), F. E. Morrow (C. & W. I.), C. H. Mottier (I. C.), C. L. Persons (C. B. & Q.), H. J. Pfeifer (T. R. R. of St. L.), H. L. Ripley (N. Y. N. H. & H.), H. M. Roeser (Bur. of Standards), C. E. Smith (Con. Engr.), H. E. Stevens (N. P.), E. E. R. Tratman (Engr. News-Record.)

Appendix A—Revision of Manual

Changes in the Manual

Page 682

Switching District—Transfer this item to "Terminals," page 681, and add:

"The term is often used in a broader sense, such as 'the Chicago switching district.'"

Page 683

Relief Track—Transfer this item from page 682 to page 683, following "Siding."

Car Capacity of Freight Tracks—Transfer this item from page 688 to follow "Relief Track;"

"In rating the capacity of freight tracks allow 42 ft, per car."

Yard Layout—As a rule it is better to arrange the main track or tracks along one side of the yard than to locate the eastbound (or southbound) and westbound (or northbound) yards on opposite sides of the main track. Another arrangement is to spread a double track main line and to place the yard between the two tracks, thus avoiding a crossing of main track to reach the yard. The engine terminal should be centrally located.

Page 684

Caboose Tracks—Caboose tracks should be so located that cabooses can be placed on or removed from them in the order of their arrival. Where conditions permit, these tracks should be so constructed that caboose can be dropped by gravity onto the rear of trains made up for departure.

Drill Tracks—Drill tracks should be free of interference from other movements and from obstructions to a clear view between an engineman working on the drill track and the switchmen working along the ladder track.

Page 685

Icing Tracks—Icing tracks should be so located that the work of placing, icing and removing cars can be performed in the least time. Requirements will be different where solid trains are iced during transit and where individual cars have to be collected, iced and classified.

Paragraph entitled Transfer Station should be put under heading "Freight Transfer Stations" on page 692.

Page 688

Strike out "Car Capacity of Freight Tracks" and item No. 1, transferred to page 683.

Insert new heading: "Freight Car Repair Yards" over items No. 2 to 6.

Page 689

Team Delivery Yards—Omit word "Delivery" and change first item to read:

"A team yard should be located convenient for use by shippers and consignees. If possible it should also be convenient to the freight house, so that the receipt and shipment of freight may be easily under control of the freight agent's force."

To the second item add: "driveways should be kept in good condition."

Hump Yards—Change second item as follows:

"Where large numbers of cars are handled, a hump yard is generally a desirable form of yard for receiving, classifying and making up trains. In many cases a greater number of classifications can be made in less time and at less cost than through any other form of yard."

Page 690

Transfer second paragraph of item No. 7 to precede No. 7.

In item No. 8 strike out the words "the receiving and."

Page 691

No. 15 add: "The cut list may be made a permanent record of car riders to assist in locating the responsibility in case of loss and damage to freight. It may also provide a record of car-rider performance."

Page 692

Yard Lighting—Add:

"Flood lights erected on lofty points are used extensively to give more diffused lighting than that of ordinary lamps. These lights may be mounted on poles or towers near and along the throat of the yard, or on enginehouses, bridges, coaling stations or other convenient elevated points."

Freight Transfer Stations—Omit paragraph No. 4. Place under this heading the "Transfer Station" item on page 685.

Additions to Manual

1. **Ladders**—Insert the ladder layouts for freight yards as given in the 1917 report.
2. **New Definitions:**

Standing Capacity of Yards—The total length in feet of all tracks in a yard (except main running tracks) divided by 42 ft.

Working Capacity of Yards—The maximum number of cars that can be dispatched from a yard in a 24-hr. period with resulting efficiency in yard service and train service.

Hump Yard Design and Operation—Insert on page 691 of Manual paragraph, pages 83 and 84 of 1922 report.

Review of Reports

A review of contents of the reports on yards and terminals was submitted in order to assist the looking up of information on specific subjects, which information may be scattered through several reports. There is also an index to this section of the 1921 "Manual" and a list of material recommended by the committee for insertion in the Manual.

Appendix B—Scales

Automatic indicating devices for weighing are patented articles, each manufacturer having his own special design and construction, based on different mechanical principles. All types are in use, which would seem to indicate that as yet no one design has been accepted as being superior.

It is impracticable at this time to prepare a specification covering the design and construction of such devices, but that a certain accuracy in weighing should be required, and that the preparation of a specification for tolerances for automatic indicating devices be assigned to the committee as part of its 1924 report.

Tolerances for Railroad Service Weighing Devices

1. Track Scales—The present specifications of the A. R. E. A. for manufacture and installation of railroad track scales, now provides a manufacturer's tolerance for the first field test. There are two well-known rules for tolerances for satisfactory maintenance of scales, one used altogether by the Bureau of Standards (Forms 565 and 566—"Supplement to Track Scales Reports") and the other appearing in the A. R. A. "Rules for the Location, Maintenance, Operation and Testing of Railroad Track Scales." For a standard grading of scales there should be a uniform tolerance, and studies made to the present time would indicate that further investigations

should be made before any definite recommendation can be submitted.

2. *Motor Truck and Depot Scales*—The specifications of the A. R. E. A. for the manufacture and installation of motor truck, built-in, self-contained and portable scales for railroad service contain a set of tolerances applying to scales manufactured and installed under this specification. While it is possible that some of the older and lighter scales now in service may not meet the requirements as to tolerances specified for the new scales, there is no direct evidence of this fact. Results of tests on some of these scales are being collected, but this information will not be available until next year, and it is suggested that for the present at least, tolerances given in the present specifications be applied to all scales of this class.

Appendix C—The Proper Size and Arrangement of Large Passenger Station Facilities as Determined by the Business Handled

It has been decided to confine the efforts of the Committee this year to a consideration of certain associated passenger station facilities which are not included in the station building but which are located in what is generally referred to as the trainshed. The character of some of these facilities is not affected by the volume of business handled. These were discussed in a general way. Other facilities, such as the station platforms and their approaches, were analyzed to determine the proper relation of the size and arrangement of these facilities to the volume of the business handled.

Types of Platforms—The various types of station platforms were discussed in a general way in the report of the yards and terminals committee for 1923. The three types of platforms which will be considered in this report are defined below:

Combined Passenger and Trucking Platform—A station platform which is used for the joint accommodation of passengers and the handling of baggage, mail and express.

Exclusive Passenger Platform—A station platform which is used only for the accommodation of passengers.

Exclusive Trucking Platform—A station platform which is used only for the handling of baggage, mail and express.

As a general proposition, a combined platform is located between pairs of tracks and serves two tracks, each track being served by but one platform. In the case of separate platforms each platform is located between single tracks with the passenger and trucking platforms alternating. By this arrangement it is possible for the passengers to use the passenger platform located on one side of the train and the station employees handling baggage, mail and express to use the trucking platform on the opposite side of the train, thus eliminating interference between the station employees and the passengers, which is highly desirable from the standpoint of the convenience to passengers as well as facilitating station operation.

Width of Station Platforms

Name of Station	No. of Platforms	Type of Platform	Platforms Classified as to Uses and Widths in Feet: Used Jointly for Passengers and Trucking									Used Exclusively for Passengers			Used Exclusively for Trucking				
			10 or less	12 to 14.9	15 to 16.9	17 to 18.9	19 to 20.9	21 to 22.9	23 to 24.9	25 to 26.9	17	13 to 14	16 to	18 24	8 to 10	12 to 14	18	26	33
1. L. V., Buffalo	5	Low		5															
2. Detroit	6	Low			1	5													
3. D. L. & W., Buffalo	4	Low	2				2												
4. Main St., Richmond	7	Low	2	5															
5. Macon Union	9	Low	1				5		2							1			
6. D. L. & W., Hoboken	9	Low					9												
7. Shreveport	4	Low		2		2													
8. Broad St., Richmond	4	Low						4											
9. Providence	11	Low	1	1	2	1	4	1	1										
10. Dallas	5	Low				5													
11. Denver	9	Low											5			4			
12. Grand Central, Memphis	7	Low		3								2				2			
13. Ottawa	4	Low					4												
14. St. Paul	11	Low					11												
15. La Salle, Chicago	6	Low		5			1												
16. Windsor, Montreal	12	Low											7		5				
17. Central, Chicago	4	Low			4														
18. Jacksonville	10	Low			10														
19. G. N., Minneapolis	6	Low					6												
20. C. & N. W., Chicago	8	Low				8													
21. Union, Kansas City	8	Low						8											
22. Indianapolis	6	Low			6														
23. Cincinnati	4	Low		1	3														
24. St. Louis	16	Low		16															
25. Washington	19	Low				3	16												
26. Grand Central, New York																			
Lower Level	14	High		5	4			1		3								1	
Upper Level	17	High			11	1	1			2							1		1
27. Penna., New York	11	High			2			8			1								
28. So. Station, Boston	20	Low										12		2	6				
29. C. of N. J., Jersey City	10	Low			4	4	2												
Totals	266		6	43	47	29	61	22	3	5	1	14	12	2	11	7	1	1	1

In last year's report the advantages of the separate platforms as compared with combined platforms were discussed in a general way. The report this year analyzed in detail the variables, such as space occupied, convenience to the public, facility of operation, and the other elements which have a bearing on the advantages of the two types of platforms and the adaptability of these types to the various kinds and sizes of terminals.

Conclusions

1. In stub stations where trains head into the station, there is a maximum interference between passenger and trucking operations.

2. If all trains are backed into stub stations there is practically no interference between passengers and trucking operations. Under these conditions, combined passenger and trucking platforms should be installed.

3. If all trains operate in one direction through a station (loop terminal operation) the approaches to and from the concourse can be so located that there would be no interference between trucking and passengers. Under these conditions combined passenger and trucking platforms should be installed.

4. If the approaches to the concourse in a through station are located in the middle of the station platforms and the station tracks are of only sufficient length to accommodate single trains, there will be interference between passengers and trucking operations; but not to the same extent as would occur in a stub terminal where trains head into the station.

5. With baggage, mail and express elevators located at the outer ends of the platforms in a through station, where the station tracks are of sufficient length to permit trains to proceed through the station so that baggage, mail and express cars can be spotted opposite the elevators, and the passenger coaches opposite the approaches to the concourse, there will be practically no interference between trucking operations and passengers. With such an arrangement and method of operation combined passenger and trucking platforms should be installed.

6. In a through station, if two trains are accommodated simultaneously on the same track and trains operate through the station in both directions, the interference which results between passengers and trucking operations is practically the same as occurs in a stub terminal, where trains head into the station.

7. Other things being equal the amount of interference between trucking operations and passengers on station platforms increases directly with the amount of passengers and baggage handled. The amount of this traffic should, therefore, be taken into consideration in determining the relative desirability of separate passenger and trucking platforms as compared to combined platforms.

Rate of Discharge of Passengers from Cars Onto High and Low Platforms

Station	Type of Platform		Width of Car Door in feet	Number of Passengers Discharged			
				Per Min.		Per Ft. Width Per Min.	
	High	Low		Suburban	Through (Coach Passenger)	Suburban	Through (Coach Passenger)
I. C., Van Buren St., Chicago	*		2.4	55		23	
I. C., 63rd St., Chicago	*		2.4	58		24	
I. C., Van Buren St., Chicago	*		4.0	77		19	
I. C., 63rd St., Chicago	*		4.0	75		19	
Dearborn Station, Chicago		*	2.0	28		14	
Dearborn Station, Chicago		*	2.4	33		14	
La Salle Station, Chicago		*	2.4	38		15	
La Salle Station, Chicago		*	3.4	44		13	
Central Station, Chicago		*	2.4		20		8
South Station, Boston		*	2.4		20		8

8. Other things being equal it is more desirable to have separate passenger and trucking platforms where through and commuter service are handled on the same platforms.

9. A 13-ft. exclusive passenger platform is the minimum width sufficient to accommodate the passengers from one arriving train, one line of travel for passengers to a departing train and a row of columns in the center of the platform. A platform of sufficient width to accommodate the passengers from two trains arriving simultaneously adjacent to the same platform is not justifiable.

10. Baggage elevators are desirable at both ends of combined passenger and trucking platforms in large passenger stations to reduce the interference between trucking operations and passengers.

11. Under normal conditions passengers discharge from trains to station platforms at approximately the following rates per single car exit:

(A) On low platforms:
- (1) From Pullmans (after hand baggage has been unloaded)—one passenger every 2.6 sec.
- (2) From day coaches—one passenger every 3.0 sec.
- (3) From suburban coaches with exit doors 2.4 ft. wide—one passenger every 1.8 sec.
- (4) From surburban coaches with exit doors 3.4 ft. wide—one passenger every 1.4 sec.

(B) On platforms at car floor level:
- (1) From suburban coaches with exit doors 2.4 ft. wide—one passenger every 1.1 sec.
- (2) From suburban coaches with exit doors 4.0 ft. wide—one passenger every 0.8 sec.

12. Speeds of passengers on station platforms under normal and satisfactory conditions are approximately as follows:

(A) When moving unrestricted as individuals:
- (1) Through passengers—4.2 ft. per sec. (2.9 mi. per hr.)
- (2) Suburban passengers—5.5 ft. per sec. (3.7 mi. per hr.)

(B) When moving as a crowd:
- (1) Through passengers—3.7 ft. per sec. (2.5 mi. per hr.)
- (2) Suburban passengers—5.1 ft. per sec. (3.5 mi. per hr.)

13. The amounts of platform space utilized by passengers when moving in a compact mass, but without objectionable congestion, are approximately as follows:

(A) Through passengers—15 sq. ft. per passenger.
(B) Suburban passengers—10 sq. ft. per passenger.

14. Capacities of station platforms in discharging passengers are approximately as follows:

(A) Through passengers—15 per ft. of width per min.
(B) Suburban passengers—30 per ft. of width per min.

15. Ramps are an ideal means of handling passengers as an approach to passenger platforms as they can be installed so as not to increase the distance traveled by passengers and do not decrease the space on the station platform available for the accommodation of trains. This can be accomplished in many cases by the use of both stairs and ramps in the approach to the platform.

16. The gradient for passenger ramps preferably should not exceed 10 per cent. Ramps of this gradient have a carrying capacity approximately as follows:

(A) Through passengers—15 per ft. of width per min.
(B) Suburban passengers—30 per ft. of width per min.

17. Elevators or escalators for heights less than 25 ft. are not recommended as approaches to individual passenger platforms. They may be desirable as a supplement to stairs for the use of the aged and invalids.

18. If instead of one elevator for each platform a battery of elevators can be arranged in sufficient number and approachable from all tracks, as might be possible in a stub terminal, so that a minimum amount of waiting will be occasioned, their use might be justified.

19. A single elevator or escalator should not be relied upon as the sole means of approach to a passenger platform.

20. Escalators have a carrying capacity of approximately thirty-three (33) passengers per ft. of width per min. They are well adapted to suburban service, but there is some question as to their practicability for through passenger service.

21. The carrying capacities of stairs decrease with increase in height. For a height of 20 ft. the carrying capacities with traffic in one direction are approximately as follows:

(A) For through passengers—10 passengers per ft. of width per min.
(B) For suburban passengers—18 passengers per ft. of width per min.

22. In combined passenger and trucking platforms in through stations, it is desirable to have a space of approximately 6 ft. on one side of the stairs to permit trucking operations past the stairs.

23. The location of the approaches to the concourse on the station platforms in a through station has a bearing on the required capacity of the approach. If it is located at the end of the platform the concentration will be but one-half as intense as if it is located at the middle of the platform, although the duration of the maximum intensity of congestion will be much less in the latter case than in the former. If a double approach is located at the center, the intensity of the concentration will be the same as in the first case and the duration of the maximum intensity of congestion will be the same as in the second case.

24. High cost of labor justifies the use of power-driven trucks and tractors in connection with trucking operations in large passenger stations.

25. Ramps are a very desirable means of providing vertical transportation for trucking operations, if the design of the station is such as to permit their installation without a material sacrifice in space.

Flow of Passengers Through Turnstiles, Single and Double Door and Ticket Gates

Type of Exit	Width in Feet	Number of Passengers	
		Per Minute	Per Ft. Width Per Min.
Turnstile	5.3	50	9
Single Door	3.0	77	26
Double Door	6.0	117	19
Ticket Gates*	....	48	....

NOTE.—This data includes Suburban Traffic only.
*One man punching ti kets (each ticket punched).

26. A gradient of 6.5 per cent is the steepest yet used to any extent for trucking ramps in large passenger stations. This gradient preferably should not be exceeded, though it is possible that trucking ramps may be operated successfully with maximum gradients of 8 per cent.

27. In stub terminals where separate passenger and trucking platforms are used and the baggage, mail and express facilities are located below the tracks, the utilization of the end of the exclusive trucking platforms adjacent to the concourse permits the installation of trucking ramps without sacrifice of space.

28. The minimum clear width which should be considered for trucking ramps designed to accommodate one line of traffic is 6 ft. and for two lines of traffic is 10 ft.

29. With a 7 ft. side clearance and track centers 12 ft. 6 in. there is a saving in width of right-of-way required for each pair of station tracks of 1 ft. 6 in. (not considering the width of column) if columns are located on the platform instead of between tracks. The columns do not increase required width of exclusive passenger platforms more than the width of the column, if it does not result in restricting the space necessary for a given number of lines of travel.

30. Exclusive trucking platforms should be of an adequate width to permit two loaded trucks to pass and should be free from columns. A width of 11 ft. is recommended as a minimum for exclusive trucking platforms.

31. Combined passenger and trucking platforms for normal conditions, allowing space on the platform for one loaded truck, should be at least 18 ft. in width, assuming a column located in the center of the platform.

32. The ratio of the required widths of right-of-way for a given number of station tracks with combined passenger and trucking platforms, as compared to exclusive passenger and trucking platforms, is approximately 1.00 to 1.11.

33. When the station capacity is governed by the arriving rush hour and the operation and design of the station is such that serious interference will result between passengers and trucking, unless the trucking operations are delayed a period of three minutes to permit the majority of the passengers to leave the platform, separate trucking and passenger platforms will increase the capacity of a station developed on a given right-of-way over what it would be if combined passenger and trucking platforms were used. If the capacity of the station is determined by the departing rush hour, the maximum capacity is obtained by the use of combined passenger and trucking platforms. If the capacity of the station is determined by a period in which the number of arriving and departing trains are equal, the capacity is independent of the type of platform used. If the time necessary to delay trucking to avoid interference with passengers is more or less than three minutes, it will correspondingly increase or decrease, respectively, the relative advantages of the separate platforms.

34. The movements of suburban passengers, through turnstiles, ticket gates, single and double doors, which might normally be expected is approximately as follows:

(A) Through turnstiles (5.3 ft. in diam.)—50 passengers per min.

(B) Through single swinging doors (3 ft. wide)—77 passengers per min.

(C) Through double swinging doors (each 3 ft. wide)—117 passengers per min.

(D) Through ticket gates (each ticket punched)—46 passengers per min.

Discussion

(A. Montzheimer, chairman, presented the report of the committee with the co-operation of the chairman of the sub-committees. In the absence of the chairman of the sub-committee on the revision of the Manual, Mr. Montzheimer presented the report and then *moved that recommendation No. 1 be adopted and printed in the Manual. Motion carried.*

J. B. Hunley (C. C. C. & St. L.), presented a report on item No. 2 which was accepted as information.

C. H. Mottier (I. C.) presented the report on item No. 3 and outlined the contents in a complete manner and then *moved that the conclusions be adopted for inclusion in the Manual.*

J. L. Campbell (E. P. & S. W.): When a committee of this Association produces an outstanding piece of work and submits it for our consideration, it is proper that the committee know that the Association appreciates its work. I desire on my own behalf to express my appreciation of the whole work of this committee and its report. Its treatment of this subject of platforms in passenger terminal facilities is masterly. If there is any member of the Association who has not read and studied that presentation of the subject, he should do so.

(Motion carried.)

Chairman Montzheimer: *I move that the three definitions in Appendix C, (1) combined passenger and trucking platform, (2) exclusive passenger platform and (3) exclusive trucking platform, be approved for publication in the Manual.*

(Motion carried.)

(The committee was then excused with the thanks of the Association.)

Report of Committee on Rail

Owing to the greatly increased wheel loads and density of traffic, there has been considerable interest in the design of heavier rail and a possible increase in the standard length. The Committee on Rail has submitted a design for a 150-lb. section for inclusion in the Manual, but it is not prepared to recommend a definite rail length in excess of the present 33-ft. standard. The rail failure statistics show an increase in the failures for the 1917 rollings. This apparently represents the peak of bad performance. A revised form for the annual report of rail failures was submitted, as were also revised specifications for quenched carbon steel and alloy steel track bolts and quenched carbon steel joint bars.. G. J. Ray has been chairman for six years and a member of the committee for eight years.

G. J. Ray
Chairman

THE COMMITTEE proposes the following revisions of the Manual:

Appendix B—Revised Specifications for Quenched Carbon Steel and Alloy Steel Track Bolts.

Appendix C—Revised Specifications for Quenched Carbon Steel Joint Bars.

Exhibit A—Revised Form 402-C, Annual Report of Rail Failures.

Exhibit B—Recommended Design for 150-lb. Rail Section.

The committee is continuing the study of rail manufacturing practices as included in the so-called "Specifications for Experimental Lots of Dead-Setting Open-Hearth Carbon Steel Rails" and has secured chemical and physical test data on approximately 100,000 tons of high silicon dead-setting steel produced at five mills in the United States and one mill in Canada. The record in general shows a better quality of material in the dead-setting steel rail than in the average output under the standard specifications without additional rejections or hardship upon the manufacturer. Before drawing further conclusions, the committee desire to study the behavior of this rail in track.

The committee presented rail failure statistics for the period ending October 31, 1922, as an Appendix A. The 1917 rollings showed an increase in the number of failures during the five years' service period, but it appears that this registers the peak of bad performance and the better records of later rollings justify the hope that the banner record of the 1914 rollings will at least be equalled within the next few years

The committee was not prepared to recommend to the Association a definite rail length in excess of the present 33-ft. standard for adoption as an alternate standard, and asked for a reassignment of the subject. Proponents of a 39-ft. rail length base their choice almost entirely upon the length of equipment available for transportation. Those advocating a 45-ft. rail length believe that equipment should not be the governing factor and that economies in track maintenance require that rail shall be the maximum permissible length consistent with proper expansion.

The specification for track bolts presented this year is identical with that approved by the Association in 1923, except for the interjection of a paragraph designating the nominal size of rolled thread bolts as the over-all diameter of the rolled threads. Considerable confusion has arisen over whether the diameter of the shank or the diameter of the rolled thread should be considered the nominal diameter and the clear definition in the specification is in line with the universal practice among American manufacturers and on most of the railways.

The specification presented for quenched carbon steel joint bars is in substance identical with the specification of the American Society for Testing Materials, the principal point of divergence being closer limits of tolerance in fit.

The committee presented a design for 150-lb. rail section as an Exhibit B. As information, there was also presented as an Appendix D, a series of different rail sections as compared with the standard A.R.A. and A.R.E.A. designs.

The committee is participating in a joint investigation of the underlying cause of transverse fissures, the parties now co-operating being the Bureau of Standards of the Department of Commerce, the Rail Manufacturers' Committee, the Joint Committee on Stresses in Track, and the Rail Committee. In order that the circumsances under which the committee consented to participate in such an enterprise might be clearly understood, there was presented in an Appendix E the original correspondence between the Bureau of Standards, which is sponsoring this work, and the chairman, together with a digest of the proceedings at the subsequent conferences.

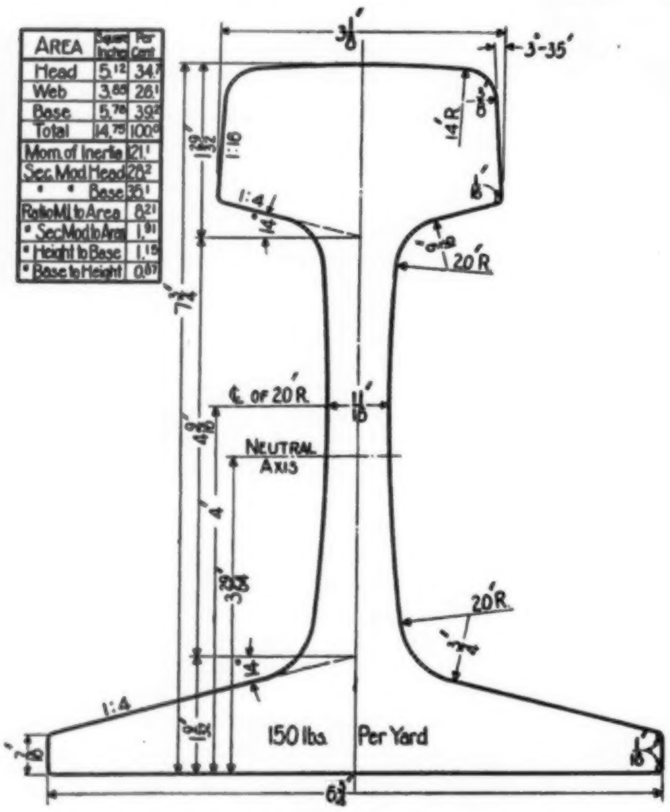
The committee reported slow progress on the study of the comparative wear of various weights of rail due to its present inability to so co-ordinate the data at hand as to yield reliable conclusions. It was hoped that further data may serve to solve the present difficulty and the effort will be continued.

The committee is co-operating with the Committee on Track in the study of rail canting, but the joint committee has so far failed to agree upon a report.

The committee is studying the movement of continuous rails through bolted joints by observing the travel of expansion in track at periodic intervals under conditions of both dry joints and lubricated joints. These observations seem to indicate that without lubrication most of the expansion is concentrated in a relatively small percentage of the joints, with consequent wide gaps during the contraction phase at these locations. With lubrication of the contact surfaces the movement appears considerably more uniform. Laboratory tests on fully bolted joints, the bolt tension being approximately 13,000

lb., show that the theoretical forces developed by a temperature change of approximately 12 deg. should suffice to slip the rail. It seemed probable that this tension is being frequently exceeded in an effort to maintain joints to their maximum efficiency as a girder, the result being a locking of the rail against expansion slip in many joints. The expansion thereupon travels until a relatively loose joint is encountered, with consequent batter at such points through improper spacing. A balanced standard of bolt tension might be possible under which the mechanical strength of the joint could be conserved without unduly restraining slip.

The committee reported progress in the report on the cause and prevention of battered rail ends and presented



Recommended Design for 150-lb. Rail Section

the belief that excessive opening between rail ends constitutes the principal cause of batter.

Action Recommended

1. That Rail Record Form 402-C, Annual Report of Rail Failures, presented as Exhibit A, be adopted by the Association and substituted for the corresponding form now printed in the Manual.
2. That the specifications in Appendix B, Specifications for Quenched Carbon Steel and Alloy Steel Track Bolts, be adopted by the Association and substituted for the corresponding specifications now printed in the Manual.
3. That the specifications in Appendix C, Specifications for Quenched Carbon Steel Joint Bars, be adopted by the Association and substituted for the corresponding specifications now printed in the Manual.
4. That Exhibit B, Design for 150-lb. Rail Section, be accepted as an American Railway Engineering Association standard and printed in the Manual.

Committee: G. J. Ray (D. L. & W.), chairman; J. M. R. Fairbairn (C. P. R.), vice-chairman; E. E. Adams (U. P.), W. J. Backes (N. Y. N. H. & H.), F. L. C. Bond (C. N. R.), W. C. Cushing (Penna.), *P. H. Dudley (N. Y. C.), J. B. Emerson (Engr. Rail Com.), C. F. W. Felt (A. T. & S. F.), L. C. Fritch (C. R. I. & P.), C. R. Harding (S. P.), J. D. Isaacs (S. P.), H. D. Knecht (M. P.), Hunter McDonald (N. C. & St. L.), R. Montfort (L. & N.), G. L. Moore (L. V.), C. A. Morse (C. R. I. & P.), A. W. Newton (C. B. & Q.), J. R. Onderdonk (B. & O.), F. L. Thompson (I. C.), F. M. Waring (Penna.), Louis Yager (N. P.), J. B. Young (P. & R.).

*Deceased.

Appendix B—Specifications for Quenched Carbon Steel and Alloy Steel Track Bolts

(Note: The specifications adopted at the 1923 meeting were published in full on page 622 of the March 14, 1923, issue of the Railway Age March Dailies. The 1924 specifications are identical with the exception of paragraph 4, which is as follows:)

(IV) Design and Tolerance

9. (a) The nominal size of rolled thread bolts shall be the over all diameter of the rolled threads.

(b) The bolts and nuts shall conform to the dimensions specified by the Railway Company, subject to the following variations: A variation of 1/32 inch under and 1/64 inch over the specified diameter of the shank of the bolt will be permitted. The diameter of the shank shall not be below the diameter of the rolled thread by more than 1/16 inch for bolts ⅞ inch in diameter and under, nor more than 3/32 inch for bolts 1 inch in diameter and over. The length of the bolt under the head shall not vary more than ⅛ inch from that specified. A variation in the dimensions of the elliptical shoulders under the head of 1/32 inch will be permitted.

Appendix C—Specifications for Quenched Carbon Steel Joint Bars

(I) Materials

1. The steel shall be made by the open-hearth process.

(II) Chemical Requirements

2. The steel shall conform to the following chemical composition:

Carbon	0.35 to 0.60 per cent
Manganese	Not over 0.80 per cent
Phosphorus	Not over 0.04 per cent

3. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. The analysis shall be made from drillings taken at least ⅛ inch beneath the surface of a test ingot obtained during the pouring of each melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 2.

4. An analysis may be made by the purchaser from a finished bar representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 2.

(III) Physical Requirements

5. (a) The joint bars shall conform to the following minimum requirements as to tensile properties:

Tensile strength, lb. per sq. in.	100,000
Yield point, lb. per sq. in.	70,000
Elongation in 2 in., per cent	$\frac{1,600,000}{\text{Tens. Str.}}$
but in no case under 12 per cent.	
Reduction of area, per cent	$\frac{3,500,000}{\text{Tens. Str.}}$
but in no case under 25 per cent.	

(b) The yield point shall be determined by the drop of the beam of the testing machine.

6. The bend test specimen specified in Section 7 shall bend cold through 90 degrees around the pin the diameter of which is equal to three times the thickness of the specimen, without cracking on the outside of the bent portion.

7. Tension and bend test specimens shall be taken from the finished bars. Tension test specimens shall conform to the dimensions of the standard A.S.T.M. two-inch test bar. Bend test specimens may be ½ inch square in section, or rectangular in section with two parallel faces as rolled, with corners rounded in radius not over $\frac{1}{16}$ inch.

8. If preferred by the manufacturer and approved by the purchaser, the following bend test may be substituted for that described in Section 6: A piece of the finished bar

shall bend cold through 45 degrees around a pin the diameter of which is equal to three times the greatest thickness of the section, without cracking on the outside of the bent portion.

9. (a) One tension and one bend test shall be made from each melt.

(b) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 and any part of the fracture is more than ¾ inch from the center of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

10. If the results of the physical tests of any test lot do not conform to the requirements specified, the manufacturer may retreat such lot one or more times, in which case two additional tension and two additional bend tests shall be made from such lot, all of which shall conform to the requirements specified.

(IV) Design and Tolerance

11. The splice bars shall be smoothly rolled, true to templet, and shall accurately fit the rails for which they are intended. The bars shall be sheared to length ,and the punching and notching shall conform to the dimensions specified by the purchaser. A variation of 1/32 inch from the specified size of holes, of 1/16 inch from the specified location of holes, and of ⅛ inch from the specified length of splice bar, will be permitted. Bars shall be straight without camber in either plane and with outside surface of web parallel to the axis of rail.

(V) Manufacture

12. The finished splice bars shall be free from injurious defects and shall have a workmanlike finish.

13. Joint bars shall be punched, slotted and shaped at a temperature of not less than 800 degrees Centigrade (1470 degrees Fahrenheit) and subsequently quenched from a temperature of 810 degrees Centigrade (1490 degrees Fahrenheit).

(VI) Inspection

14. The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the splice bars ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the splice bars are being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

15. (a) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples.

(b) Splice bars which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

16. Samples tested in accordance with Section 4 which represent rejected splice bars shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

(VII) Marking

17. The name or brand of the manufacturer and the year of manufacture shall be rolled in raised letters and figures on the side of the rolled bars and a portion of this marking shall appear on each finished splice bar.

Discussion

(The report of the committee was presented by G. J. Ray, chairman.)

Chairman Ray: *I move that Rail Record 402-C, be adopted by the Association and printed in the Manual in preference to the one which is now there.*

(*Motion carried.*)

(The specifications for quenched carbon steel and alloy steel track bolts, were presented by the sub-committee chairman, T. B. Young [P. & R.])

Mr. Young: These specifications are identical with those passed by the Association last year. Through some misunderstanding they were not published in the Manual. There is one change or addition that I would like to make to the specification. In Section 3, Physical Requirements, after Paragraph 8, no provision is made for a retest similar to the one in Section 10. I recommend that Section 10 be a new Section 9 and the present Section 9 be renumbered 10 and the subsequent sections renumbered accordingly. With that change *I move that these specifications be adopted and published in the Manual in lieu of the ones already there.*

(*Motion carried.*)

(Mr. Young next presented the specifications for quenched carbon steel joint bars. *It was then moved and carried that they be adopted for inclusion in the Manual.*)

Chairman Ray: The committee recommends the adoption of the 150-lb. rail section as standard recommended practice for that weight of rail. *I so move.*

C. W. Baldridge (A. T. & S. F.): The question of the width of head of this 150-lb. section of rail has appealed to me. As a consequence, I secured a copy of the manual, of the mechanical division of the American Railway Association and secured the standard form of locomotive drive wheel tread and have had that built into a life sized drawing of this rail. That shows that the change in angle of the tread of this locomotive tire, which is the widest wheel we have, occurs directly over the inside point or regular point of the fillet. It does not seem that we need that width of rail head, and that the difference in the amount of metal in the head of this rail as proposed, and the amount of metal in the head

Size of Form 8½ x 21 in.

Rail Failures for the Year Ending October 31, 192....

RAILROAD ....

Exhibit A

Form 402-C

Item	Kind of Steel	Specified Carbon		Mill	Year Rolled	Pounds per Yard	Section	Railroad	Tons New Rail Laid	Equivalent Track Miles	Mile-Year	Period	Number of Failures																									Failures per 100 Track Miles per Year of Rail in Service
													Broken					Head					Web					Base					Total					
		Min	Max										A	B	L	U	Total	A	B	L	U	Total	A	B	L	U	Total	A	B	L	U	Total	A	B	L	U	Total	
1												This Year																										
												Total to Date																										
2												This Year																										
												Total to Date																										
3												This Year																										
												Total to Date																										
4												This Year																										
												Total to Date																										
12												This Year																										
												Total to Date																										
13												This Year																										
												Total to Date																										
14												This Year																										
												Total to Date																										
15												This Year																										
												Total to Date																										

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of the 130-lb. rail could be used to better advantage in deepening the head than it is in widening it.

Mr. Cushing: There are two lines of thought on this subject. Everybody agrees that we should have as wide a head as possible in order to get proper support for the angle bar. That is a necessity, and also as wide a head as feasible for the bearing area of worn wheels and worn rails. This width of head is substantially the width of head which has been used for so many years by the New York Central lines, and the 130-lb. section of the Pennsylvania. It is fully recognized that the Master Car Builders' wheel tread is not a good profile for a wheel tread from our point of view. The late Dr. Dudley was of so decided an opinion on that subject that he had the New York Central lines' wheel tread changed to what I would consider a very much better shaped tread than the established Master Car Builders' standard, for the reason that you speak of.

(*Motion carried.*)

(The report of the sub-committee on the desirable length of rails was next presented by E. E. Adams, U. P., chairman.)

Mr. Adams: In discussing the desirable length of rails we first took under advisement the possibility of recommending a rail of 39 ft. in length. The primary object in recommending 39 ft. was due to the further multiple of it and to being able to handle them in our present day equipment, but after we got into this a little further, we found that there were a lot of railroads that could not even transport a 39-ft. rail without bringing in special equipment. The idea of 45-ft. and 60-ft. rail was considered. The 60-ft. rail was finally dropped, on account of the probable trouble that we would have with expansion, yet it was not definitely decided that we could not handle a 60-ft. rail. We further discussed the question among ourselves and finally came back and took a vote on 39 and 45-ft. rails, and we were so divided among ourselves that we didn't feel that we should make a recommendation. Hunter McDonald (N. C. & St. L.), made some studies on uniformity of expansion on his road, and he has gone into this very thoroughly on a small test section that he has, having in mind that the expansion is not uniform, that whether or not our adopted expansions that we all follow are correct.

L. J. F. Hughes (C. R. I. & P.): I have noticed in going over the report on rail failures consideration is given only to the life of the rail. In other words, no consideration is given to the tonnage passing over the rail. The diagram in the report is manifestly unfair to the various rail mills because in this diagram, the number of failures is tabulated contrasting the results of the different mills and no consideration is given to the number of tons passing over these rails.

Chairman Ray: That matter has the thorough consideration of the committee, has had during the past year and will have during the coming year.

C. W. Gennet, Jr. (Robt. W. Hunt & Co.): It is folly, of course, to expect that each rail making up the total of a contract will be of identical quality, and that it will when laid in the ordinary way yield uniform results and life. Most of the mills are not perfectly willing to divide their rails into various classifications and to load separately the rails of the different classes in so far as is practicable. This co-operative spirit should be taken advantage of by the roads, and pains taken to regulate the use of certain rails whose most probable characteristics may be easily recognized. Thus it can be arranged for all "A" or top rails to be shipped separately for use in special places, while other rails from heats of over .70 carbon can be similarly shipped separately for use on curves. Other classifications can be provided for which if carried out in comparatively small degree only may be expected to produce valuable results.

Some progress has been made toward having the ordinary "A" rail, or top metal of ingots, rolled into the hot punched tie plates. Three mills are now equipped to do this and, in fact, at one the practice is frequently taken advantage of on that mill's own intiative. Unfortunately the increased price asked for hot worked tie plates has been a serious deterrent to the extension of what would be a comparatively simple way of eliminating the most unsatisfactory rails. From 12 to 15 per cent of all rails shipped are "A" rails, and roughly 50 per cent of all failures occur on them. Strangely, they command the standard price. But, No. 2 rails that constitute 5 per cent of the shipments, and rarely ever provoke a failure, cost two dollars per ton less than other rails. Would it not be feasible to correct this paradoxical matter in some way and encourage the practice desired, perhaps by agreement to abandon the extra price for hot worked plates provided all No. 2 rails made could be shipped at the standard price?

I am not in sympathy with the movement to increase the carbon in heavy rails, because of feeling that by so doing the liability of decreasing the ductility is so enhanced that failures, and especially fissures, are likely to be invited. It has been rather definitely established that fissures predominate in heats with the higher carbons, but to what extent high carbon steel alone or the hazards of soaking pit treatment contributes most, is, of coure, an unsolved mystery. In this connection the necessity seems pressing for some generous trials of rails rolled from steel of what may be called radical composition. The present standard composition of open-hearth rail steel was arrived at very much by the rule of thumb, and it is by no means certain that the usual proportions of carbon, manganese and phosphorus is the best that can be obtained for our purpose.

Mr. Baldridge: Some investigators claim that the earlier rails failed by transverse fissures but that no attention was paid to them. It is not difficult to prove that such is not the case, since thousands of miles of rails, rolled before the beginning of transverse fissure history, are still in use and under the wheels, and they are not now failing from transverse fissures. Rails which have been manufactured since the transverse fissure became a reality, do not stop failing in that manner upon being moved to light traffic lines or to side tracks; therefore, if the older rails had been failing from transverse fissures in their first locations they would still be failing from that cause. The proper place to search for the cause of transverse fissures is, therefore, in those points of difference between the old rail and that of recent manufacture. Two differences exist which are well known, one is the process of manufacture and the other the chemistry of the steel.

In addition to the use of such a chemical requirement, the specifications for the rolling should include a provision that no re-carbonizing or other reagent shall be added to the steel after it has been drawn from the furnace, except that the reagent be in a molten condition.

Chairman Ray: In regard to getting some rail rolled of the same composition of this old Bessemer rail which did so well in service, that has been tried on some roads and without success. Furthermore, I call your attention to the fact that the last Bessemer rail that was rolled in any great quantity at the different mills with very little exception was an absolute and utter failure. Whether high phosphorus can be introduced into an open-hearth rail and made a success is a matter which might be given consideration.

The A. R. E. A. Elects New Officers

Results of the Annual Election Announced Yesterday
George J. Ray Elected President for Ensuing Year

Early in the afternoon session yesterday President Lee called upon Secretary Fritch to announce the results of the election of officers for the ensuing year, as follows:

President, G. J. Ray, chief engineer, Delaware, Lackawanna & Western, Hoboken, N. J.;

Vice-President, C. F. W. Felt, chief engineer, Atchison, Topeka & Santa Fe system, Chicago.

Secretary, E. H. Fritch.

Treasurer, George H. Bremner, engineering department, Chicago, Burlington & Quincy, Chicago.

Directors, A. M. Burt, assistant vice-president operating, Northern Pacific, St. Paul, Minn.; A. F. Blaess, engineer maintenance of way, Illinois Central, Chicago; W. P. Wiltsee, chief engineer, Norfolk & Western, Roanoke, Va.

Members of nominating committee: M. C. Blanchard, chief engineer, Western lines, Atchison, Topeka & Santa Fe, Amarillo, Tex.; Frank Lee, assistant engineer maintenance of way, Canadian Pacific, Winnipeg, Man.; J. E. Willoughby, chief engineer, Atlantic Coast Line, Wilmington, N. C.; R. H. Ford, assistant chief engineer, Chicago, Rock Island & Pacific, Chicago, and C. C. Cook, assistant engineer maintenance of way, Baltimore & Ohio, Baltimore, Md.


J. M. R. Fairbairn
First Vice-President


G. J. Ray
President


C. F. W. Felt
Second Vice-President

George J. Ray, President of the American Railway Engineering Association

The election of George J. Ray as president brings to the American Railway Engineering Association an executive who typifies the ideals of that association. His active participation in the work of the society is well known to all members attending the conventions and his desire to serve and be served by the association has won the respect and confidence of all who have come in contact with him. As chief engineer of the Delaware, Lackawanna & Western, Mr. Ray has been afforded unusual opportunities to develop and advance the science and practice of engineering design and construction in all its relations to finance, traffic and maintenance. As an engineer, little can be added to what is already common knowledge among railway men, for all are familiar with the large projects which he has carried out on the Lackawanna.

But back of this work and, in fact, an integral part of it, is the man whose personality and ability have made it possible. Frank, thoughtful, interesting and interested, imbued with a deep love of horticulture and a touch of the artist, he possesses an intensely human and likable personality that softens and yet strengthens a character deeply analytical, far-sighted, practical, vigorous and courageous. These characteristics have marked Mr. Ray as an outstanding figure among railway men. Many of those who might be adversely affected by his vigorous analytical manner of attacking questions are instead warmed and impressed by the distinct humanness of the man and the sincerity of his interest in the work of others. As an executive of the association it may be expected that he will apply his knowledge of railway problems to the work of the association with the same clear understanding of the problems of others that has always characterized his relations with his associates on the Lackawanna and, in earlier years, on the Illinois Central.

In the association, George Ray has been particularly active, having served as a member of the track committee from 1909 to 1916, inclusive, and as chairman in 1917 and 1918; as a member of the rail committee in 1917 and 1918 and chairman since that time. He has also been a member of the standardization committee

since 1920, of the special committee on stresses in track since 1915 and of the new committee on co-operative relations with universities since its organization in 1923. In addition to this work for the association, Mr. Ray was a member of the Board of Direction from 1914 to 1917 and again in 1922. The following two years he was second vice-president and first vice-president of the association.

Born in Illinois and educated at the University of Illinois, Mr. Ray began his railroad work in the same section of the country as an employee of the Illinois Central. Here he acquired a knowledge of many of the fundamentals of railway construction and maintenance, being employed as a transitman, assistant engineer, supervisor of track and roadmaster until 1903 when he was appointed division engineer of the Delaware, Lackawanna & Western at Scranton, Pa., probably the most important point on that road. This was at a time when the Lackawanna was undertaking its extensive rebuilding program and because of the tremendous amount of work which the engineering department had before it, there fell on Mr. Ray almost the entire responsibility of designing and building the new facilities at Scranton. These included practically every angle of railway work, such as car and locomotive shops, terminal buildings, yards, stations, bridges, changes in grade and alinement, etc. The work formed an excellent training for the more advanced work which he took up, following his appointment as chief engineer in 1909. His work since that time is too well known to need anything more than mention here. Under his direction the development and use of concrete in railway construction received a marked impetus. Notable among the work involving this class of construction are the famous Tunkhannock, Martins Creek and other viaducts on the heavy realinement projects and the grade separation work in the Oranges where he initiated the extended use of reinforced concrete flat slab construction for railway bridge structures. Much of this work was epoch making and its successful completion and justification from engineering, financial and operating standpoints are a worthwhile tribute to the ability of Mr. Ray, his sound judgment, his faith in his convictions and his courage to fight for them to the end. As a man and as an executive the association secures in the new president those qualities which are distinctly valuable to it.

American Railway Engineering Association Registration

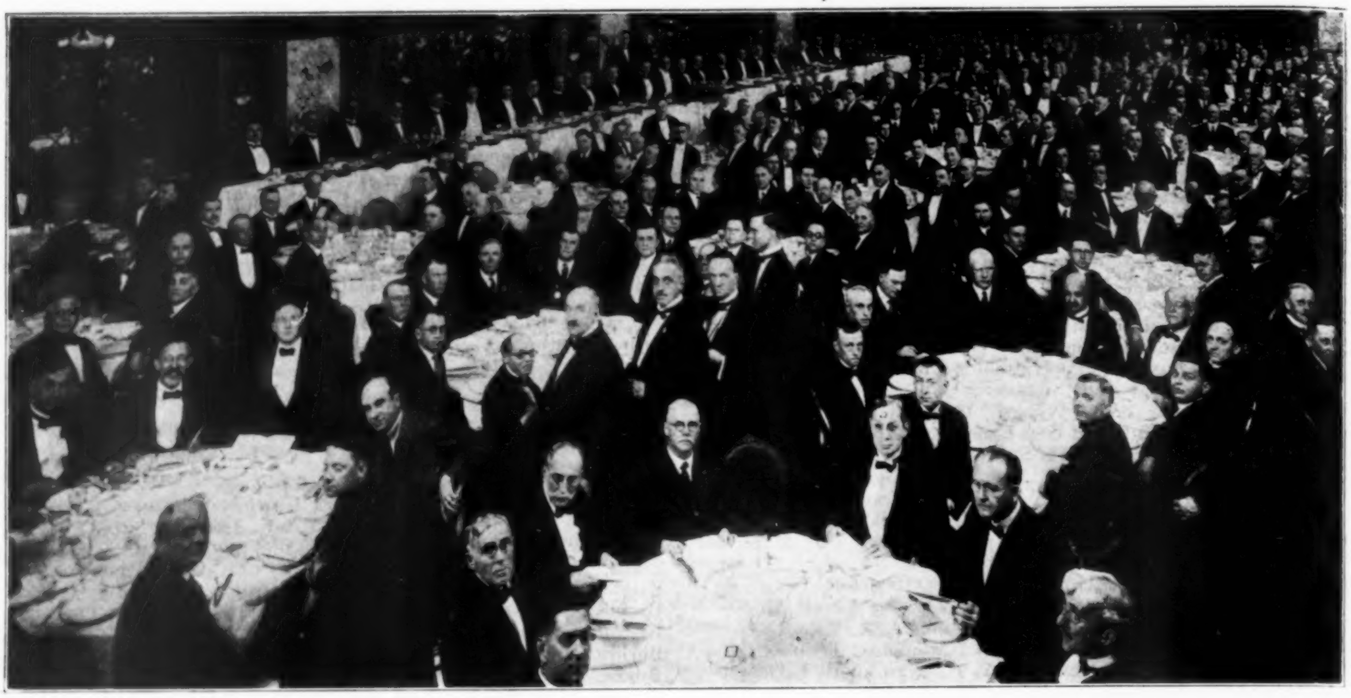
THE TOTALS obtained at the close of yesterday's registration of the American Railway Engineering Association added 242 names to the registration recorded on Tuesday, thus making the total for the two days 950, as compared with 788 for the first two days last year. Wednesday's registration is divided as between 178 members and 64 guests, as compared with 154 members and 47 guests for the second day of last year. The registration follows:

Adsit, C. R., asst. div. engr., B. & O., Akron, Ohio.
Alden, C. A., ch. engr., Frog & Switch Department, Bethlehem Steel Co., Steelton, Pa.
Alfred, F. H., pres. and gen. mgr., P. M., Detroit, Mich.
Allen, L. B., engr. m. of w., C. & O., Richmond, Va.
Anderson, Arthur, jr. engr., N. Y. C., Chicago.
Armstrong, W. R., asst. ch. engr., O. S. L., Salt Lake City, Utah.
Arn, W. G., asst. ch. engr., Chicago Terminal Improvements, I. C., Chicago.
Baldwin, R. A., engr. constr., Can. Nat., Toronto, Ont., Canada.
Barry, G. R., supt., Penna., Richmond, Ind.
Bates, F. E., bridge engr., M. P., Kirkwood, Mo.
Bayer, E. J., engr. M. of W., E. I. & T. H., Washington, Ind.
Blackie, G. F., asst. ch. engr., N. C. & St. L., Nashville, Tenn.
Bohland, J. A., bridge engr., G. N., St. Paul, Minn.
Bond, L. H., asst. engr. maint. of way, I. C., Chicago.
Bortin, H., consulting engr., 408 Olive St., St. Louis, Mo.
Botts, A. E., div. engr., C. & O., Huntington, W. Va.
Bragg, R. R., div. engr., C. R. I. & P., Dalhart, Tex.
Brown, C. B., ch. engr., Can. Nat., Montreal, Canada.
Brown, C. W., supt., L. & N. E., South Bethlehem, Pa.
Brown, H. W., asst. engr., Penna., St. Louis, Mo.
Brum, G. M., fuel oil sta. insp., C. R. I. & P., Chicago.
Bryant, C. T., asst. engr. m. of w., C. C. C. & St. L., Wabash, Ind.
Burt, J. W., div. engr., C. C. C. & St. L., Indianapolis, Ind.
Charleston, C. W., eng. acct., C. B. & Q., Lincoln, Neb.
Clark, H. G., asst. to president, C. R. I. & P., Chicago.
Coates, F. R., president, Community Traction Co., Toledo, O.
Comstock, G. F., met. engr., Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Cook, C. C., maintenance engr., B. & O., Baltimore, Md.
Copeland, R. D., supervisor of track, Wabash, Montpelier, O.
Cowsert, John M., foreman, Water Department, Mo. Pac., Gorham, Ill.
Cronin, J. F., asst. engr., Oklahoma Ry. Co., Oklahoma City, Okla.
Cunningham, C. C., div. engr., C. R. I. & P., Herington, Kan.
Dale, L. E., div. engr., Penn. Sys., Philadelphia, Pa.
Dalstrom, O. F., engr. of bridges, C. & N. W., Chicago.
Darrow, F. T., asst. chief engr., C. B. & Q., Lincoln, Neb.
Davis, M. B., asst. engr., I. C., Carbondale, Ill.
Dennis, Walt, supt., N. J. I. & I., South Bend, Ind.
Dewees, A. R., div. engr., P. M., Detroit, Mich.
Dick, H. B., asst. val. engr., B. & O., Baltimore, Md.
Dunn, O. T., asst. engr., I. C., Champaign, Ill.
Dupuis, L. C., div. engr., Can. Nat., Quebec, Canada.
Eberly, G. F., asst. maint. engr., B. & O., Baltimore, Md.
Edmonson, G. N., div. engr., N. Y. C., East Albany, N. Y.
Ekberg, C. E., Bridge Dept., Nor. Pac., St. Paul, Minn.
Engle, C. W., engr. m. of w., C. C. C. & St. L., Wabash, Ind.
Ellis, V. C., asst. engr., I. C, Chicago
Evans, John, div. engr., M. C., Detroit, Mich.
Fair, J. M., supvr., Penn. Sys., Philadelphia, Pa.
Farrin, J. M., asst. engr., I. C., Chicago.
Farlow, G. B., asst. engr., B. & O., Western Lines, Cincinnati, O.
Ford, C. F., supvr. tie and tbr. dept., C. R. I. & P., Chicago.
Fraser, J. A., designer in Bridge Dept., A. T. & S. F., Chicago.
Freeman, J. E., National Concrete Specialties Co., Peoples Gas Bldg., Chicago.
Fritch, L. C. (past-president), vice-pres. in chg. of op., const. and maintenance, and cap. expenditures, C. R. I. & P., Chicago.
Gabriel, R. W., asst. div. engr., B. & O., Washington, Ind.
Gaines, R. H., engr. m. of w., T. & P., Dallas, Tex.
Geyer, C. J., asst. supt. m. of w., C. & O., Richmond, Va.
Giles, W. H., asst. engr., Mo. Pac., St. Louis, Mo.
Goos, J. H., insp. engr., G. N., St. Paul, Minn.
Graham, F. M., engr. m. of w., Penna., Columbus, O.
Grandy, A. L., asst. to pres. and gen. mgr., P. M., Detroit, Mich.
Graves, J. W., asst. engr., Erie, Scranton, Pa.
Green, F. W., v.-pres., St. L. S. W., Tyler, Texas.
Gzowski, C. S., Jr., ch. engr. const. dept., C. N., Montreal, Canada.
Haff, F. W., instrumentman, C. B. & Q., Centralia, Ill.
Haggander, G. A., bridge engr., C. B. & Q., Chicago.
Hales, F. S., asst. engr., N. Y. C. & St. L., Cleveland, O.
Hamilton, G. F., distr. engr., C. B. & Q., Alliance, Neb.
Hammond, E. W., engr. m. of w., B. R. & P., Rochester, N. Y.
Hanger, Kenneth, engr. M. of W., M. K. & T., Dallas, Tex.
Harding, C., supvr. B. & B., Grand Trunk, Battle Creek, Mich.
Harrington, C. J., roadmaster, Y. & M. V., Memphis, Tenn.
Hayes, V. R., supervisor track, Wabash, Forrest, Ill.
Haywood, A. E., asst. engr., Grand Trunk, Battle Creek, Mich.
Heggie, W. G., office engr., G. T., Detroit, Mich.
Hervey, C. L., 137 McGill St., Montreal, Canada.
Hewes, John, Jr., div. engr., B. & O., Washington, Ind.
Hobbs, W. H., asst. engr., Mo. Pac., St. Louis, Mo.
Hodgman, B. B., v.-pres. and ch. engr., National Water Main Cleaning Co., New York City.
Hogue, C. J., mgr. Forest Products, West Coast Lumbermen's Association, New York City.
Holmes, M. V., roadmaster, A. T. & S. F., Ottawa, Kan.
Holmgren, A. T., asst. engr., N. P., Laurel, Mont.
Houston, W. O., div. engr., M. C., Jackson, Mich.
Hovey, M. H., consulting engr., Madison, Wis.
Huntsman, F. C., asst. engr., Wabash, Moberly, Mo.
Jonah, F. G., asst. to pres., St. L.-S. F., St. Louis, Mo.
Johnson, B. O., asst. to vice-pres., N. P., St. Paul, Minn.

Johnson, J. E., div. engr., P. M., Saginaw, Mich.
Johnston, D. B., div. engr., Penna., Louisville, Ky.
Kelley, W. J., instrumentman, C. R. I. & P., Cedar Rapids, Ia.
Kenly, R. G., asst. to pres and ch. engr., M. & St. L., Minneapolis, Minn.
Kern, J. W., Jr., dist. engr., I. C., New Orleans, La.
King, F. R., asst. engr., C. M. & St. P., Pewaukee, Wis.
Koren, J. D., div. engr., N. P., Spokane, Wash.
Kuehn, A. L., pres., American Creosoting Co., Louisville, Ky.
Kulp, B. R., div. engr., C. & N. W., Madison, Wis.
Laird, A. N., asst. engr., Grand Trunk, Detroit, Mich.
Lancaster, W. C., elect. engr., board of est. and apportionment, 2700 Municipal Bldg., New York City.
Lentz, C. W., roadmaster, I. C., Mattoon, Ill.
Lewis, O. A., Wabash, Montpelier, Ohio.
Lillie, J. S., land and tax agent, G. T., Detroit, Mich.
Lockwood, R. J., asst. mgr., United Ry. Co. of St. Louis, St. Louis, Mo.
Longshore, R. L., div. engr., Wabash, Montpelier, O.
Maney, Thomas, 1370 Third St., Louisville, Ky.
Mann, B. H., sig. engr., M. P., St. Louis, Mo.
Manson, E. F., div. engr., C. R. I. & P., Chicago.
McClurg, J. G., asst. engr., A. T. & S. F., Chicago.
McFetridge, W. S., princ. asst. engr., B. & L. E., Greenville, Pa.
McGuigan, Francis H., Jr., asst. to pres., Railway Car Manufacturers' Association, New York City.
Meek, R. W., sig. engr., S. P., Texas Lines, Houston, Tex.
Metcalf, J. M., princ. asst. engr., M. K. & T., St. Louis, Mo.
Miller, J. L., engr. bridges, N. Y. C., Yonkers, N. Y.
Morgan, M. B., dist. engr., Y. & M. V., Memphis, Tenn.
Murray, W. A., engr. of track, N. Y. C., New York City.
Nagel, John R., div. engr., Mo. Pac., Poplar Bluff, Mo.
Newlin, J. A., Forest Prod. Lab., Madison, Wis.
Nickerson, J. C., roadmaster, L. & N., Paris, Ky.
Paquette, C. A., ch. engr., C. C. C. & St. L., Cincinnati, Ohio.
Parsons, O. V., asst. engr., N. & W., Bluefield, W. Va.
Passmore, E. W., div. engr., C. B. & Q., Lincoln, Neb.
Perkins, H. M., asst. engr., N. P., St. Paul, Minn.
Peterson, H. R., draftsman bridge dept., N. P., St. Paul, Minn.
Phelps, Wm. H., div. engr., S. P. Co., Oakland, Calif.
Piety, P. T., instrumentman, C. & A., Springfield, Ill.
Pilcher, H. B., Jr., asst. engr., Wabash, Montpelier, Ohio.
Pringle, J. F., transportation engr., Can. Nat., Toronto, Canada.
Purdy, J. W., asst. div. engr., B. & O., Garrett, Ind.
Ray, A. L., asst. engr., G. T. W., Durand, Mich.
Reimann, Robert, asst. engr., B. & O., Relay, Md.
Rhodes, W. R., asst. engr., Mo. Pac., St. Louis, Mo.
Richardson, J. J., div. engr., Can. Nat., Cochrane, Ont., Canada.
Riegler, L. J., asst. engr., Penn. Sys., Pittsburgh, Pa.
Riley, D. A., engineering dept., B. & O., Baltimore, Md.
Ringer, Frank, ch. engr., M. K. & T., St. Louis, Mo.
Rist, C. J., div. engr., P. M., Saginaw, Mich.
Rockefeller, R. P., asst. to vice-pres., C. M. & St. P., Chicago.
Robinson, E. F., ch. engr., B. R. & P., Rochester, N. Y.
Roller, W. L., asst. engr., H. V., Columbus, O.
Roney, J. G., asst. engr., Penna., Pittsburgh, Pa.
Rossiter, L. P., div. engr., L. V., Buffalo, N. Y.
Russell, W. E., roadmaster, I. C., Clinton, Ill.
Schmidt, Edward C., prof. of ry. engr., Univ. of Ill., Urbana, Ill.
Sessions, O. H., gen. roadmaster, D. & T. S. L., Monroe, Mich.
Sedwick, B. F., asst. engr., B. & O., Baltimore, Md.
Shepard, H. M., asst. ch. draftsman, New York City.
Shillander, A. A., res. eng., I. C., Chicago.
Sillcox, L. K., gen. supt. motive power, C. M. & St. P., Chicago.
Sills, J. M., dist. engr., St. L.-S. F., Springfield, Mo.
Skov, L. W., office engr., bridge dept., C. B. & Q., Chicago.
Smith, C. U., dist. engr., C. M. & St. P., Milwaukee, Wis.
Smith, H. R., asst. engr., P. M., Detroit, Mich.
Snyder, J. A., div. engr., M. C., Detroit, Mich.
Splitstone, C. H., supt. of construction, Erie, New York City.
Squire, F. C., engr., Pres. Conf. Comm., Chicago.
Staley, G. L., asst. bridge engr., M. K. & T., St. Louis, Mo.
Stansbury, H. E., res. engr., E. P. & S. Sys., Tucumcari, N. M.
Steel, D. A., assoc. ed., Railway Age, Chicago.
Stevens, J. W., div. engr., N. Y. C., Rochester, N. Y.
Stewart, G. H., supervisor, Penna., North Philadelphia, Pa.
Stubbs, R. M., engr. bridges, M. K. & T., St. Louis, Mo.
Sturdevant, C. F., div. engr., C. B. & Q., Lincoln, Neb.
Talbot, A. N., prof. municipal and sanitary engineering, University of Illinois, Urbana, Ill.
Thompson, M. D., asst. engr., Chicago Terminal Improvements, I. C., Chicago.
Thornton, Sir Henry W., chairman and pres., C. N., Montreal, Canada.
Unger, J. S., mgr., Cent. Research Bur., Carnegie Steel Co., Pittsburgh, Pa.
Utter, A. H., asst. engr., C. B. & Q., Lincoln, Neb.
Van Ness, R. A., asst. engr., A. T. & S. F., Chicago.
Wait, B. A., instrumentman, C. R. I. & P., Des Moines, Ia.
Wakefield, G. M., asst. div. engr., B. & O., Chillicothe, O.
Wells, L. W., gen. mgr., T. M., Terrell, Tex.
Wendling, G. C., roadmaster, L. & N., Nashville, Tenn.
Westbrook, J. T., asst engr., I. C., Water Valley, Miss.
White, J. L., supt. transportation, A. C. L., Wilmington, N. C.
Williams, C. C., prof. civil engineering, University of Illinois, Urbana, Ill.
Williams, G. P., asst. engr., maint. of way, L. I., Jamaica, N. Y.
Williams, H. W., special representative to supt. of motive power, C. M. & St. P., Chicago.
Williams, K. G., resident engr., Union Ry. Co., Memphis, Tenn.
Worthington, E. D., asst. engr., Valuation Department, Mo. Pac., St. Louis, Mo.

Guests

Allen, G. H., London, England.
Bell, C. M., asst. engr., I. C. R. R., Chicago.
Bernstein, Harry, student, Armour Institute, Chicago.
Berry, R. B., student, Armour Institute, Chicago.
Biggs, W. T., asst. engr., C. & A., Bloomington, Ill.
Black, J. C., editor, Engineering and Contracting, Chicago.
Brightwell, C. E., superv., C. & O., Huntington, W. Va.
Brochran, James, supvr., C. & O., Maysville, Ky.
Bryant, Harry, inspection water service, M. P., St. Louis, Mo.
Burkly, M. G., Chicago.
Burns, M. C., insp. water service, St. Louis, Mo.
Burrie, C. C., superv., B. & O., New Philadelphia, O.
Connor, C. L., track superv., Erie, Newark, N. J.
Cress, E. E., University of Illinois, Urbana, Ill.
Derrig, J. T., dist. engr., N. P., St. Paul, Minn.
Dowdall, E. J., Universal Portland Cement Co., Chicago.
Dunlap, J. H., sec., Amr. Soc. Civil Engrs., New York.
Dunn, G. L., superv. track, Erie, Port Jervis, N. Y.
Farrell, W. J., A. R. A.
Ferguson, H., supt. track, C. N., Toronto, Canada.
Fritch, E. H., Jr., Forest Park, Ill.
Friedman, H. C., Chicago Elevated, Chicago.
Gelmore, R. W., asst. engr., B. & O., Cincinnati, Ohio.
Gibault, J. E., div. engr., C. N., Levis, Quebec, Canada.
Gillis, John J., American Steel & Wire Co., Boston, Mass.
Gilmore, R., supt., C. N., Montreal, Canada.
Hyne, T. A., pres., South Bend, Ind.
Jarvis, F. E., Chicago.
Johnson, H. C., signal superv., C. & O., Covington, Ky.
Kennedy, A. D., asst engr., A., T. & S. F., Chicago
Kirk, H. W., chief clk to ch. engr., Ann Arbor, Owosso, Mich.
Lewis, W. H., pres., F. J. Lewis Mfg. Co., Chicago.
Lichty, C. A., gen. insp., C. & N. W., Chicago.
Little, T. E., superv., Water Service, C. N., Montreal, Que., Canada.
Lynch, J. H., roadmaster, C. R. I. & P., Chickasha, Okla.
Malone, J. I., superv., B. & O., Cleveland, O.
Mann, J. R., supt. trans., D. & T. S. L., Detroit, Mich.
Marguardsen, R. P. V., asst. engr., I. C. R. R., Chicago.
Martin, L. E., asst. engr., B. & O., Dayton, Ohio.
Morrison, H. T., C. N., Toronto, Canada.
Morrow, Wilson, div. engr., B. R. & P., Du Bois, Pa.
Milne, O. P., instrumentman, N. Y., C. & St. L., Frankford, Ind.
Naylor, F. W., asst. to chief transp., C. N., Montreal, Canada.
Nelle, F. R., student, Armour Institute, Chicago.
Nichalt, W. P., superv. track, C. & O., Glen Morgan, W. Va.
Nicholson, C. H., mgr. steamships, Can. Nat. Rys., Toronto, Canada.
Niederhofer, E. L., Chicago.
Noland, C. J., asst. engr., Chicago Union Station Co., Chicago.
North, James H., l. l. to v. p. and gen. mgr., L. & N. E., Philadelphia, Pa.
O'Brien, R. O., instrumentman, G. T. W., Durand, Mich.
Pasmussen, Richard, Chicago.
Pawn, Z. L., University of Illinois, Urbana, Ill.
Putney, F. C., insp., Penna. Camp Hill, Pa.
Quinn, O., roadmaster, D. & R. G. W., Grand Junction, Colo.
Reinert, W. A., asst. prof. in C. E., Armour Institute, Chicago.
Riney, M., C. & N. W., Baraboo, Wis.
Schmidt, F. H., asst. engr., A., T. & S. F., Chicago.
Schmidt, T., Jr., Chicago.
Schulman, Louis, Armour Institute, Chicago.
Soloman, H., Chicago.
Tucker, Lester W., Henry R. Kent & Co., Rutherford, N. J.
Weber, C. F., C. B. & Q., Chicago.
Whipple, C. A., asst. engr., H. V., Columbus, O.
Willcox, M. M., asst. engr., P. M., Detroit, Mich.



The Annual Dinner in the Gold Room Last Night

The A. R. E. A. Holds Most Successful Dinner

Instructive Addresses by Prominent Speakers and Several Unique Features Score Great Success

THE GOLD ROOM of the Congress hotel was filled to overflowing at the annual dinner of the American Railway Engineering Association last evening. The "Standing Room Only" sign was hung out early yesterday afternoon when the last seat was sold, after which time it was necessary to turn a number of applicants away.

That this interest was not misplaced was evidenced by the approval which greeted each feature of the program during the evening. The advance announcement of the Arrangement committee that "something different" was planned, was borne out in the marked departure of almost every detail of the program from those of preceding years. Admission to the dinner was by means of an annual pass on the "AREA" railway (The Lee Lines). The dinner menu and the program were presented in the form of a tourist ticket with numerous coupons, a reproduction of which accompanies this article. Music was furnished by the Chicago Ladies' Chorus, a club of 25 young ladies, supplemented by a Pullman Porter's Quartet, both of which received voluminous applause.

The addresses established a new high level for dinners of the association, Fred W. Sargent, vice-president and general counsel of the Chicago & Northwestern, Chicago, spoke on "Transportation in Relation to Proposed Legislation." He was followed by Sir Henry W. Thornton, chairman of the Board of Directors and president of the Canadian National railway system, who spoke on "The Railways and the State." The program was concluded by a humorous address by James Schermerhorn, lecturer and former editor of the Detroit Times, who kept the audience convulsed with laughter by his pointed remarks on current topics and his fund of wit. An interesting "surprise" was added by the unexpected appearance of Henry Van Tromp, a prominent Dutch financier, who took occasion to make many pointed references to railways and railway men. The tension was relieved greatly by the announcement at the conclusion that he was a prominent Chicago attorney.

The entire program was broadcasted from Westinghouse station, KYW, Chicago, through which agency it was heard by many beyond the convention hall. Several railroads advised their outlying officers of the fact that this program would be broadcasted, thereby increasing the number who "listened in."

The addresses of Sir Henry W Thornton and Mr. Sargent follow in abstract:

Give the Public the Facts

By F. W. Sargent

Vice-President and General Counsel, Chicago & North Western.

MACAULAY SAID, "Of all inventions, the alphabet and printing press excepted, those inventions which abridge distance have done most for civilization." The phenomenal growth of the United States has again emphasized this truth and brought into conspicuous attention the railroad transportation of this country, which has not only abridged distance from the standpoint of space, but has likewise abridged it from the standpoint of time.

The results achieved record the triumphs of the engineer. What we enjoy today is largely the work of his effort.

One thing that the constructive engineers of each period must not overlook is that back of their effort, and making it possible, has been and is the constructive

thought actuating men and women who devote their financial savings to the cause of industrial, and thereby human, progress. Nowhere do we find a more distinct, more characteristic illustration of the interdependence of accumulated savings, called capital, and engineering genius than in the transportation field.

The problem of the engineer has been not only that of efficient construction, maintenance and operation, but also that of accomplishing the necessary result within the available financial means. The engineer to be successful must understand not only the problem involved in his immediate calling, but likewise he must be acquainted with the larger engineering problems of finance.

If we could only apply to the problems of government the same careful and exact mental attitude that you, as engineers, apply in your profession, most of our political difficulties would vanish like the dew before the morning sunshine. The science of government involves every phase of human relationship. It is, therefore, the most far-reaching is its influence. But there is no other science that receives so little thought by those responsible for its administration—the qualified electors everywhere, a majority of whom in recent times haye placed very little value upon their citizenship. Witness modern elections of radicals in states where less than 40 per cent of the qualified voters went to the polls.

A Subtle Form of Graft

There is a subtle and indirect form of political graft that needs the immediate attention of the electorate of our common country. It emanates from men seeking political preferment by unreasoning and untruthful attacks upon our industrial and financial institutions. Witness the vicious attacks upon the national banking system and the deplorable distress extant everywhere in the young republic when Hamilton's policies were for a while cast aside and our forefathers experimented with wildcat banks and worthless paper money. The men today who would break down our federal reserve system and destroy the efficiency of our railroads would likewise have aligned themselves with the enemies of our national banking system had they lived in the period to which I refer.

The danger is no less today unless a remedy is applied now and with promptness and vigor. If I have any criticism of the Federal Reserve Bank it lies in the fact that that institution is not conducting a sufficiently vigorous campaign through the public press to acquaint the people everywhere with the true facts and principles and to dispel the clouds of falsehoods and misrepresentations that have been created by the lung power rather than the brain power of some of our modern statesmen.

Less than eight per cent of the farmer's expenses are represented by transportation charges and the effort of the demagogue has been to convince the farmer that if a part of this eight per cent of his expenses were removd most of his difficulties would vanish.

A resolution has recently been introduced in the Senate of the United States, proposing to investigate the publicity campaign of the railroads, and among other things it is resolved "that the Commttee on Interstate Commerce be and is hereby directed, either as a whole or by sub-committee, to investigate the extent, character, methods and purposes of propaganda emanating directly or indirectly from the common carrier railroads," etc., etc.

Fred W. Sargent | Sir Henry W. Thornton | James Schermerhorn

It would probably be equally as consistent to have a committee of the Congress of the United States investigate the purposes of an argument by an attorney in behalf of his client to a jury. The jury in the present case is made up of the people of the United States, and the railroads are going directly to them, believing they are entitled to know the facts and to have the answers to many false and misleading statements that are emanating from men in positions of high political trust, some of which are sent broadcast at the expense of the taxpayers by means of the franking privilege.

"War Cries" of Demagogues

One of the most common "war cries" was to the effect that the Esch-Cummins law guaranteed the railroads a fixed return, and many people came to accept this statement as true. The public is gradually beginning to learn that it has been deceived.

Almost every day, however, we read some tirade against the railroads; arguments based upon statements which cannot be proven, notwithstanding the fact that all matters pertaining to our railroad systems are open

books and the records are on file with the Interstate Commerce Commission.

It was asserted by men who have recently been elected to the United States Senate that the federal government was guaranteeing certain fixed returns to the owners of railway securities. That the valuation of the railroads as fixed by the Interstate Commerce Commission in 1920 was fixed under the so-called Esch-Cummins law, when, as a matter of fact, the Esch-Cummins law only directed the Interstate Commerce Commission "to utilize the results of its investigation under Section 19a and give due consideration to all the elements of value recognized by the law of the land for rate-making purposes."

I have seen speeches by one senator who used this sort of false propaganda to help work his way to Washington—that the value of the railways as fixed by the Interstate Commerce Commission was based on peak war-time prices. This notwithstanding the fact that the members of the Commission made it plain that the prices used were the average unit prices over a period of years as they existed prior to 1914.

Men in public office who onght to know, and who claim to know something about the railroad problem, told their audiences, while campaigning for election, that the Interstate Commerce Commission allowed millions of dollars of value on watered stocks and bonds. This notwithstanding the fact that the Commission itself has pointed out that it completely ignored all stocks and bonds and confined its determination of value to its studies in the physical valuation work that was far advanced under the La Follette Valuation Law of 1913.

Is it possible that the great mass of the thinking American people believe these statements? Apparently they place some confidence in them when they cast their votes for men who were willing to accept election to the Congress of the United States under such deliberate and false propaganda. The newspapers, especially in the middle western territory, have been filled with material of this kind emanating from men whom the people had a right, or thought they had a right, to trust.

Regardless of Facts

Another United States Senator some time ago said: "A railroad train operated by five men now can carry ten times as big a load as could be carried twenty years ago." This statement was untrue, and a brief reference to the records of the Interstate Commerce Commission would have demonstrated to the senator that the average freight train load for the period to which he referred had increased 112 per cent instead of 900 per cent.

In this connection the senator said: "In spite of the great labor cost reduction per ton-mile, it costs the farmer more to ship and labor does not get enough to keep it from striking." Another untruth, but it went broadcast throughout the senator's territory as an argument showing why freight rates could be reduced because there had been a labor cost reduction per ton-mile in the transportation of the farmer's products. At the time this statement was made the records on file with the Interstate Commerce Commission showed that durlng the period referred to by the senator, to-wit: from 1901 to 1921, labor cost increased from .415 cents to .902 cents per ton-mile, so that there was an increase in the labor cost per ton-mile of more than 100 per cent instead of a reduction per ton-mile, as asserted by the senator.

Another United States senator in making his campaign for office, said that the propery investment account of the railroad companies became the principal evidence and principal basis of the valuation of nineteen billion dollars as found by the Commission in 1920. And this notwithstanding the fact that Chairman Hall of the Commission testified in January, 1922, as follows: "I have seen suggestions that what this Commission did was to accept substantially the property investment account of the carriers as the basis of its valuation, which, as stated in our report, aggregated $18,900,000,000. That was not the fact. The work of valuation of the railroads had been going on since 1913."

Other similar propaganda has been published broadcast in speeches by congressmen, senators and others throughout the entire middle western territory. And now because the carriers have seen fit to go direct to the people with their case and to present to them the truth and the facts underlying their transportation systems they, too, are to be investigated by the Congress to find out why they have had the temerity to contradict these statements and to tell the people the truth and all the truth in so far as they are able to reach them through the press and from the public platform.

Freight Rates on Farm Products

The senior senator from Wisconsin has offered joint resolution No. 62, providing that freight rates on agricultural products be reduced to the pre-war basis—by which he means to the 1913 basis. This means that the roads in the western district would have no net over fixed charges—and that the larger granger railroads would be forced into bankruptcy. The companies which perform the great bulk of the transportation service of Wisconsin are the Chicago, Milwaukee & St. Paul, which has not paid a dividend since 1917; the Chicago & North Western, which has now been obliged to reduce its dividend to a four per cent basis, and the Chicago, St. Paul, Minneapolis & Omaha, which has been obliged to pass its common dividend this year.

If the senator's proposal should pass it would mean that these carriers would not have enough revenues to pay operating expenses and taxes, let alone anything for interest or dividends.

Railway taxes per mile of road are now 160 per cent higher than they were in 1913. In the western district operating expenses are 122 per cent higher than they were in 1913, while operating revenues are only 90 per cent higher than in 1913. Since 1913 the railroads of the western district have increased their property investment by 17 per cent, but in 1923 their net railway operating income was less than it was in 1913.

In the face of this situation how is it possible for thinking men entrusted with the great power of legislation solemnly to propose in the Senate of the United States to reduce rates to the 1913 level?

Legislation on Valuation

But this is not all. The same senator has offered a bill to change the whole scheme of railway valuation. In 1913 he sponsored the present valuation law. Now that the work thereunder is nearing completion and after the government and the railroads have spent over 80 million dollars, it is proposed to abandon the plan and go to the so-called prudent investment theory. The La Follette Valuation Law of 1913 named the three elements constituting measure of value for rate-making purposes, to-wit: Cost of reproduction new; cost of reproduction new less depreciation, and original cost to date.

These are the elements which the Congress of the United States announced to all investors would be given their proper relative weight and consideration pursuant to the decisions of the courts, in measuring the value of railway properties. Such has been the announced law of our land by the decision of our courts for more than a quarter of a century, and the established policy of Congress for more than a decade. It has become a rule of property with relation to railway investments. It is now

AREA RAILWAY
The Lee Lines
From SOUP
To NUTS
Via CONGRESS HOTEL
MARCH 12, 1924
Issued by
AREA RAILWAY
G. J. Ray, Vice-Pres.

Good for One Continuous Round of Pleasure, subject to the condition in which you start.

From SOUP
To NUTS

via program designated on attached coupons

1st. GOOD GOING at 7 P. M., March 12, 1924, via Congress Hotel, Chicago, Ill. Good going all the evening.

2nd. SLOP-OVERS not permitted. If necessary the waiters will feed you.

3rd. IDENTIFICATION. Good only when presented by some member of the American Railway Engineering Association in good standing, or any friend of said member who would lend him money whether he were or not.

4th. BAGGAGE. Will be accepted if properly corked and carefully concealed. Passengers must carry their own packages.

5th. NON-TRANSFERABLE. Also illimitable and indescribable.

6th. ALTERATIONS. Subject to alterations only by the trainmaster who is likely to.

7th. RESPONSIBILITY. The speakers will not be responsible beyond their own lines, and not really responsible for some of them.

8th. LIMIT. The roof.

G. J. RAY,
Vice-Pres.

418 — Good for **ONE TRANSFER** with extraordinary luggage via any taxi at the usual rates **HERE to HOME**

418 — **FROM the Sublime TO the Ridiculous** via JAMES SCHERMERHORN of Detroit

418 — **PULLMAN PORTERS' QUARTET** will brush you off your feet with **SOME MORE MELODY**

418 — Good for Railway Engineers to hear **SIR HENRY WORTH THORNTON, K.B.E.** (meaning Kanada's Biggest Engineer) President of the Canadian National Railways, the World's Longest Railroad Longest mileage Longest paying dividends

418 — Maj. Gen. Thornton, K. B. E., and all the rest of it, will be followed by **THE LADIES' CHORUS** (And no wonder)

418 — Thirty Minutes' Stop for Oratorical Fireworks Display by **FRED W. SARGENT** of Chicago Vice-President and General Counsel of the Chicago & North-Western Railway

418 — Ten Minutes' Wait to watch the passing of **The Presidential Special** **E. H. LEE**

418 — A Few Miles of Music by **THE ORCHESTRA** From Jazz to Grand Uproar

proposed to repudiate it all for an uncertain impracticable standard called prudent investment.

Who is to be the judge of prudence? Under our system of government it might be imprudent politicians, looking backward rather than forward. Who would be willing to trust his or her savings invested in securities to the hindsight of men who have never assumed the responsibility of a pay-roll or financed the rolling of a steel rail? The prudent investment theory will keep new capital from any industry to which it may be applied.

The need of the hour is for self-discipline in the ways of honest thought, and this applies with special emphasis to those in high places of political trust charged with the responsibility of regulating our common carrier systems to the end that the railroads may maintain their efficient service and continue to contribute their share to the general prosperity.

The Railways and the State

By Sir Henry Thornton

Chairman and President, Canadian National Railways

IN THESE DAYS every country appears to have a railway problem. In some states the problem is one of reconstruction and reorganization necessitated by the ravages of the war; elsewhere it may be dissatisfaction with private enterprise, or again an effort in the direction of reduced freight rates; but whatever the movement may be it seems to be an expression of unrest and dissatisfaction with the part the transport system is playing in the life and development of the community. Various solutions have been suggested, covering the entire scale of human endeavor, without apparently effecting a permanent remedy.

We who have lived on this side of the Atlantic and enjoyed the untold blessings of tranquillity and freedom from warfare, can hardly appreciate the necessity for that eternal vigilance which elsewhere has been the only price at which existence could be purchased. However much the European may deplore the excursions of Mars which have afflicted his continent from time immemorial, his point of view with respect to war, by heredity alone, is fundamentally different from our own feelings on the subject, and he views the intervention of the state with respect to his railways as a necessary effort to strengthen the military machine. It is interesting to observe that the state ownership of railways has not thus far invaded the United Kingdom, probably for the reason that the United Kingdom itself has never been invaded or pillaged by the enemy since the days of William the Conqueror in the eleventh century. In making this statement I ignore the air raids of the Germans during the late war, as the damage inflicted was relatively negligible.

On the North American Continent, with the exception of the Canadian National Railway System, there has been a general commitment to the principle of privately-owned railways. This has come about, first, because in a new country the poverty of the government must necessarily leave much to private initiative, and secondly, freedom from attack and invasion relieved the state of the acquisition of the transport system as a military adjunct. But, as intimated at the outset of my remarks, there seems to be sufficient complaint, as well as threats, to keep these private enterprises in a state of defense, and to some degree a state of turmoil.

Essential Factors of Railroad Problem

I have no desire or intention to embark upon an argument for or against state ownership of railways, but I think I may from a somewhat varied experience in the

418 — And Then **THE LADIES' CHORUS** The ladies sound so nice when they sing we wish ladies would always

418 — **DEMI** Hotel dialect meaning they will now pass a **CUP OF COFFEE** with Cigars and Cigarettes

418 — Six Minutes for Coal **THE PULLMAN PORTERS' QUARTET** Them Boys Sure Can Sing

418 — Five Minutes for **REFRESHMENTS** Bombe a la Cox (Whatever that is) Assorted Cakes

418 — A Little More Harmony by the **LADIES' CHORUS** And Gawd knows we need it

418 — The Well-Known Team **ROMAIN & ENDIVES** (French Dressing)

418 — **PULLMAN PORTERS' QUARTET** will now make up **Lower G and Upper E**

418 — Good for One **ROAST TENDERLOIN OF BEEF** and Trimmin's includin' Sweet Potatoes Palmyra and so forth Eat hearty. It's a rare opportunity.

418 — **Another View of the LADIES' CHORUS**

418 — Ten Minutes' Stop for Fish **FILET OF BASS, SHRIMP SAUCE** Potatoes Parisienne

418 — **PULLMAN PORTERS' QUARTET** Standard Sleeping Car Porters Surcharged with Harmony

418 — **PUREE OF PEAS, AUX CROUTONS** with Celery and Olives **Quiet is requested for the Benefit of Passengers who have retired**

418 — Twenty Sweet Singers **FROM the Chicago Musical College TO the Delight of Everybody**

418 — Good for **One Blue Point Cocktail** The Best We Could Do

railway profession point out some of the essential factors of the problem which may be employed as a yardstick to measure your position, and the ground-work for our subsequent discussion may be summarized as follows:

(1) An adequate means, at reasonable cost, for the conveyance of persons and goods from one place to another within the frontiers of any country, and the performance of that same function with respect to international traffic, is essential for the advancement of civilization and the development of industrial life.

(2) Transportation has a greater effect upon, and is more intimately connected with, the daily life of the individual and the welfare of the nation than almost any other form of commercial activity.

(3) For these reasons transportation, of which the railway is the most efficient expression, has from all time been regarded as an important function of the state, or, if delegated to private enterprise, the state has exercised a constantly increasing scrutiny and regulation in the interests of its citizens.

Any lapses of sufficient duration and importance are likely to prove a discontent which finds expression in a demand for government ownership.

Arguments for State Ownership

Those who favor the government ownership of railways generally advance something like the following arguments:

First—That railways play such an important part in the life of the community that they cannot be safely entrusted to private ownership, lest discrimination, injustice and various irregularities develop.

Second—That under state ownership rates and fares can be fixed upon that scale which will best promote development and progress.

Third—That, broadly speaking, a higher degree of justice will be accorded to communities and the public in general than under private ownership.

Arguments for Private Ownership

Those who favor private ownership and operation of railways generally contend:

First—That state-owned and operated railways are inefficient, unprogressive and expensive, largely because of the impossibility of divorcing entirely the railway administration from the field of politics and the feeling that officers and employees working for the state have less reason for initiative and industry than those who are employed by private corporations.

Second—That in a democracy, the more that is left to private initiative, the better.

Third—That state ownership is a form of paternalism treading closely upon the heels of socialism.

As a matter of fact, beyond the general and broad statement that transportation has such a vital effect upon the community that it should properly be in the hands of the state, and the argument that the interjection of politics in any railway system is bound to produce disaster, there is not much to be added either for or against government ownership, and the problem becomes entirely a matter of expediency in individual states. What may be necessary or desirable in one country may be quite the reverse in another, and some formula must be sought which will give expression to this principle.

Essentials for Private Ownership

There are three cardinal principles essential to the existence of any railway as a private enterprise:

(1) It must maintain solvency and meet its financial obligations.

(2) It must furnish adequate transportation at reasonable rates to the public.

(3) It must pay to its employees that wage which, under reasonable conditions, will permit them to live in decency and comfort under sanitary conditions, and to educate and bring up their children as self-respecting members of society.

Let us elaborate a little these three principles.

Solvency, which is to say the ability to meet obligations, is the first factor in the existence of any institution. A railway which finds itself insolvent is not only placed in the hands of a receiver, but, being unable fully to perform its transportation obligations to the community, becomes a menace and a deterrent to progress and development. Therefore, obviously, solvency must be maintained.

A railway which, though solvent, imposes rates and fares which throttle the industrial life of the community and produce discomfort among its citizens, cannot be permitted to pursue such a course without increasing protest and the probability of exciting state intervention.

If the wages paid and the working conditions imposed upon the employees are of such a character as to provoke strikes and continued interruptions of traffic, again, in the interests of the community, there must be some form of correction at the hands of the state.

A material departure from any of these three principles by privately owned railway systems will probably excite a demand for state ownership, and a departure from all three will in time inevitably produce that result. For example, in Canada a considerable proportion of our railway mileage was threatened with insolvency, and the government of that day took over those properties in the interest of the Dominion. There has been some contention as to whether this course was wise or not. In my opinion, for what it is worth, I think it would have been difficult to have pursued any other policy. At any rate, it was insolvency which brought into existence the Canadian National Railway System, and, quite apart from the merits of the argument, I know of no practicable way to dispose of that system without great loss to the Dominion, accompanied, perhaps, by a considerable and detrimental restriction in service.

A Social Factor

There is another factor which bears upon the problem of state ownership, which is social in character. The unprejudiced observer cannot fail to note an increasing spirit of discontent and dissatisfaction in the masses of the public in all countries with respect to the distribution of wealth. The world as a whole produces sufficient to preclude the existence of hunger and misery among the people of any community except, of course, when there may be occasional periods of famine, and in such cases the surplus production elsewhere should be sufficient to provide sustenance. But in all countries, states and cities there do exist in certain quarters misery, distress and hunger, and any system of distribution which permits the existence of such things is fundamentally inefficient if not actually wrong. It is an insufficient answer to say that suffering is the result of incompetence or a lack of industry and enterprise, or that the average individual receives what he deserves. Such arguments neither appease hunger nor clothe the naked, and the fact remains that for decades there has been a constantly increasing feeling on the part of the great body of the people that our system of distribution of wealth is wrong and should be changed. Increased taxation to the rich, income taxes, death duties—all of these things which find expression in the statutes of almost every country today—merely indicate the kind of evolution which is

going on in the minds of the public, and, curiously enough, we accept today as reasonable what we regarded but yesterday as nothing short of confiscation.

What is the responsibility which rests upon those who have it within their power to influence the minds of men? It seems to me it is their responsibility to so administer the affairs in their charge as to permit the advancement of social life and the development of economic problems by evolution rather than by revolution, and, above all, to speed on the work of educating each oncoming generation; for, in a democracy, the government can possess no greater intelligence than that of the average intelligence of the electorate.

What bearing has this upon the state ownership of railways, and is it an important factor in the examination of that problem? It has this bearing: it produces in the minds of the great mass of the people the feeling that state ownership of railways is a step towards an improvement in that scheme of distribution with respect to which they complain, and it furnishes a fertile soil for the propagation of the theory of government-owned railways.

Conclusions

Any discussion, such as the one which is now being inflicted upon you, can only be worth while if it can be summarized into concise conclusions for the purpose of provoking intelligent and useful discussion. May I, therefore, recapitulate the conclusions which have already been somewhat elaborated:

(1) An adequate means of transportation at such rates and under such conditions as will promote industry and progress is essential to the well-being of any nation.

(2) There is an inherent conception that transportation is properly the function of the state, but, where it is delegated to private enterprise, the state is justified in maintaining such scrutiny and regulation as will prevent abuse.

(3) Under existing circumstances the advisability of state ownership of railways depends upon the conditions existing within the frontiers of each nation; but a departure from the three cardinal principles previously laid down will probably provoke government ownership.

(4) The undercurrent of dissatisfaction which exists to a considerable degree among the masses of most nations is a danger sign which should not be ignored by those who wish to retain in private hands those forms of industry which vitally affect the welfare of the community.

(5) State ownership is only practicable in the presence of an enlightened and intelligent population, and in the event of complete divorcement from influences other than those which have for their object the welfare of th community.

(6) The fate of our great railway undertakings will depend to a very large degree upon the sagacity, the justice and statesmanship of those who administer these properties during the present uncertain period, when the psychology of men is undergoing a rapid change and development throughout the civilized world.

The Signal Section A. R. A. Meets in Chicago

Twelve Committee Reports to Be Discussed at Two Day Annual Convention at the Drake Hotel

The Signal section of the American Railway Association will open its fourteenth meeting in the ballroom in the south wing of the Drake Hotel, at 10 o'clock this morning. Its sessions will continue through Friday, extending from 10 a. m. until 12:30 p. m. and the afternoon sessions from 2 p. m. to 5 p. m.

This meeting has been scheduled for Thursday and Friday with the idea of avoiding, as far as possible, sessions simultaneous with those of the American Railway Engineering Association. This enables members of the Signal section who are also members of the A.R.E.A. to attend the first three days sessions of the A.R.E.A. without interfering with their attendance at the convention of the Signal section. While the reports of the committees of the Signal section that are of special interest to engineering and operating officers have been scheduled for Friday forenoon to permit members of the A.R.E.A. to be present. It is expected that they will be particularly interested in the report of the Committee on Economics of Signaling, which includes definite data and charts showing the savings produced by signaling on single track lines.

The session this morning will open with the address of chairman B. T. Anderson (C. & O.), which will review the year's work of the Signal section, and include recommendations for action on important matters in the signal field. The report of the secretary, H. S. Balliet, (N. Y. C.), and of the Committee of Direction should bring forth statistics showing the unusual growth of the section during the year and an outline of work planned for the several committees during 1924.

A report which is awaited with special interest is that of the Special Committee on Highway Crossing Protection, which will be considered this morning. The report presents definite standards for the aspects and indications for highway crossing signals of the wig-wag and flashing-light types. This subject has been considered for over two years. It is highly important that these standards be adopted at once, in order to standardize the indications of highway crossing signals throughout the country.

Specifications for an electro-mechanical interlocking unit electric lever section are included in the report of the committee on Mechanical Interlocking. The opportunity to reduce construction and operating costs through the use of this type of interlocking, warrants definite action on this specification at this time.

The program this afternoon will start with a paper by H. G. Morgan, signal engineer of the Illinois Central. This will be followed by the reports of the committees on Instructions, Chemicals, and Designs. Complete detailed instructions regarding the installation, maintenance and operation of storage batteries, in signaling and interlocking, together with directions for the proper handling of insulated wire, form the major portion of the report on Instructions. The report of the Chemical committee includes specifications for motor gasoline, which are based on the specifications of the U. S. Government for

motor gasoline as issued by the Committee on Lubricants and Liquid Fuels, of the Bureau of Mines, and are now being presented to the Signal section for inclusion in the Manual.

The Committee on Designs will present five revised drawings and five new drawings, including drawings for electric lamps and adapters, mechanical dwarf signals, enameled steel signal blades, a base for a one-way wall machine, and the bonding of manganese frogs. A revision of the specification for one-inch wrought iron pipe will also be recommended by this committee.

The report of the Committee on Contracts and Valuation will open the program on Friday morning. It includes such items as revisions of the tables of interlocking units, and forms for invitations to bidders on signal and interlocking work. The report of the Committee on A. C. Signaling includes a complete discussion and recommendations as to methods of line charging of storage batteries used for automatic signaling. The report of the Committee on Signaling Practice is brief but important, in that it recommends that derails in main tracks be abolished. The adoption of this report by the Signal section will form a definite basis on which the railroads can formulate their pleas to state commissions for the removal of derails.

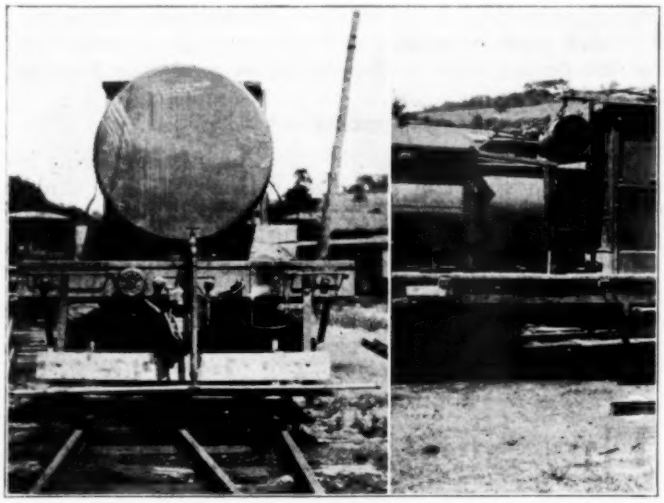
A report of special interest to operating and engineering officers, is that of the Committee on Economies of Railway Signaling, which is scheduled to be presented at 11:45 a. m., Friday. This report, entitled Increasing the Capacity of Single Track, explains by time charts how it is possible to eliminate train delays by automatic signaling, made possible by eliminating train stops for written train orders, delays at sidings, etc.

On Friday afternoon reports on D. C. Automatic Signaling and on Overhead and Underground Lines will be presented. The report on d.c. signaling is of special benefit to signal inspectors and maintainers in testing switch circuit controller contact resistances and in making train shunt tests. The report also includes specifications for low voltage d.c. automatic block signals and for track bonding. The report on overhead and underground lines includes complete specifications covering such items as line tension, clearances, pole replacements, tables and conduit construction. This assignment of this committee is involved with work of a similar nature of the Telegraph and Telephone section of the A.R.A. which has already adopted specifications of a like nature. At a meeting of representatives of the Telegraph and Telephone section, the Construction and Maintenance section, the Electrical section and the Signal section, it was agreed to harmonize these specifications. Therefore the specifications on overhead and underground lines as prepared by the Telegraph and Telephone section, with a few changes, will be presented to the Signal section for approval.

Pushing Ahead With the Track Laying Train on the Alaska Railway

Successful Results Reported with Dolge Weed Killer

THE PROCESS OF exterminating weeds by chemicals is now pretty thoroughly understood by maintenance of way officers, for it has been tried out on most roads and is being employed regularly in many sections of the country. Among recent contributions to the general information on this subject are data furnished with regard to the application of and results obtained with a solution known as Dolge Weed Killer, produced by the Dolge Weed Killer Company, Westport, Conn. The solution is diluted with 40 parts of water preparatory to its application by the sprinkling method. The photograph shows the manner in which



The Way a Traction Company Applied Dolge Weed Killer

it was applied by the East Liverpool & Beaver Valley Traction Company in Steubenville, Ohio. In this case the forward end of a car was equipped with a tank of 2,000 gal. capacity. A platform was built over half of the car above the tank, the process then being to elevate the barrels from the ground by means of a cable and pulley attached to the top of the car and then to roll the barrels in position over the man hole. The man hole was equipped with a section of galvanized iron, so shaped as to prevent splashing of the contents on the men employed in filling the tank. The sprinkling system in this case consisted simply of perforated pipe about eight feet long extending across the track in front of the car. In other cases more complete arrangements have been used in order to permit the thorough sprinkling of the roadbed at speeds upward of 15 and 20 miles an hour and to permit a variation in the distribution of the chemical. In such cases compressed air is used to increase the rapidity of distribution of the chemical.

On one road the chemical solution was applied to a right-of-way 14 ft. wide at the rate of six to eight miles a day with a crew of five men. In this case the cost was $17 a day. The treatment is said to have been satisfactory, the chemical serving not only to kill the tops of the weeds but to destroy the roots of the grasses. In another case an Indiana railroad is reported to have cleared its right-of-way of weeds at the low rate of $12.02 per mile. As with other chemical processes it has been found that while one application of the Dolge weed killer is sufficient in some places, many instances arise where a repeated application is advisable.